



**Calhoun: The NPS Institutional Archive**  
**DSpace Repository**

---

Theses and Dissertations

1. Thesis and Dissertation Collection, all items

---

2006-12

# Industry analysis for body armor procurement

Foust, Coleen; Jenson, Christopher

Monterey, California. Naval Postgraduate School

---

<http://hdl.handle.net/10945/10067>

---

*Downloaded from NPS Archive: Calhoun*



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

**Dudley Knox Library / Naval Postgraduate School**  
**411 Dyer Road / 1 University Circle**  
**Monterey, California USA 93943**

<http://www.nps.edu/library>



# **NAVAL POSTGRADUATE SCHOOL**

**MONTEREY, CALIFORNIA**

---

## **MBA PROFESSIONAL REPORT**

---

**Industry Analysis for Body Armor Procurement**

---

**By: Coleen Foust  
Christopher Jenson**

**December 2006**

**Advisors: Bryan Hudgens  
Rene Rendon**

*Approved for public release; distribution is unlimited.*

THIS PAGE INTENTIONALLY LEFT BLANK

<b>REPORT DOCUMENTATION PAGE</b>			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.				
<b>1. AGENCY USE ONLY (Leave blank)</b>		<b>2. REPORT DATE</b> December 2006	<b>3. REPORT TYPE AND DATES COVERED</b> MBA Professional Report	
<b>4. TITLE AND SUBTITLE:</b> Industry Analysis for Body Armor Procurement			<b>5. FUNDING NUMBERS</b>	
<b>6. AUTHOR(S)</b> Coleen Foust and Christopher Jenson				
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> Naval Postgraduate School Monterey, CA 93943-5000			<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>	
<b>9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b> N/A			<b>10. SPONSORING / MONITORING AGENCY REPORT NUMBER</b>	
<b>11. SUPPLEMENTARY NOTES</b> The views expressed in this report are those of the author(s) and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
<b>12a. DISTRIBUTION / AVAILABILITY STATEMENT</b> Approved for public release; distribution is unlimited			<b>12b. DISTRIBUTION CODE</b>	
<b>13. ABSTRACT (maximum 200 words)</b>  In order to leverage buying power, reduce costs and improve supplier management, the United States Air Force (USAF) needs to take a strategic approach to acquiring goods and services. Both academic and business literature promotes strategic sourcing as a viable method of minimizing cost and guarding against materials disruptions. In addition, the Office of Management and Budget has required that each agency create strategic sourcing initiatives, monitor the cost savings and reports the results to the Office of Federal Procurement Policy. However, utilization of strategic sourcing techniques and processes within the USAF is relatively new and its full benefit has not been realized. Continued efforts by the USAF to integrate strategic sourcing into its acquisition processes will yield further cost savings and other related supply chain improvements. To assist with improving the strategic sourcing efforts of the USAF, this research seeks to identify viable methodologies for conducting industry analysis. This is important and relevant because conducting an industry analysis is a critical step toward developing an effective sourcing strategy.				
<b>14. SUBJECT TERMS</b> Industry Analysis, Body Armor, Contracting, Commodity Council, Strategic Purchasing, Strategic Sourcing, Procurement, Supply Chain Management			<b>15. NUMBER OF PAGES</b> 97	
			<b>16. PRICE CODE</b>	
<b>17. SECURITY CLASSIFICATION OF REPORT</b> Unclassified	<b>18. SECURITY CLASSIFICATION OF THIS PAGE</b> Unclassified	<b>19. SECURITY CLASSIFICATION OF ABSTRACT</b> Unclassified	<b>20. LIMITATION OF ABSTRACT</b> UL	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18

THIS PAGE INTENTIONALLY LEFT BLANK

**Approved for public release; distribution is unlimited**

**INDUSTRY ANALYSIS FOR BODY ARMOR PROCUREMENT**

Coleen Foust, Captain, United States Air Force  
Christopher Jenson, Captain, United States Air Force

Submitted in partial fulfillment of the requirements for the degree of

**MASTER OF BUSINESS ADMINISTRATION**

from the

**NAVAL POSTGRADUATE SCHOOL  
December 2006**

Authors:

---

Coleen Foust

---

Christopher Jenson

Approved by:

---

Bryan Hudgens, Lead Advisor

---

Rene Rendon, Support Advisor

---

Robert N. Beck, Dean  
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

# **INDUSTRY ANALYSIS FOR BODY ARMOR PROCUREMENT**

## **ABSTRACT**

In order to leverage buying power, reduce costs and improve supplier management, the United States Air Force (USAF) needs to take a strategic approach to acquiring goods and services. Both academic and business literature promotes strategic sourcing as a viable method of minimizing cost and guarding against materials disruptions. In addition, the Office of Management and Budget has required that each agency create strategic sourcing initiatives, monitor the cost savings and reports the results to the Office of Federal Procurement Policy. However, utilization of strategic sourcing techniques and processes within the USAF is relatively new and its full benefit has not been realized. Continued efforts by the USAF to integrate strategic sourcing into its acquisition processes will yield further cost savings and other related supply chain improvements. To assist with improving the strategic sourcing efforts of the USAF, this research seeks to identify viable methodologies for conducting industry analysis. This is important and relevant because conducting an industry analysis is a critical step toward developing an effective sourcing strategy.



THIS PAGE INTENTIONALLY LEFT BLANK

## TABLE OF CONTENTS

<b>I.</b>	<b>INTRODUCTION.....</b>	<b>1</b>
A.	CHAPTER OVERVIEW .....	1
B.	BACKGROUND .....	1
C.	PROBLEM STATEMENT .....	2
D.	PURPOSE OF STUDY.....	3
E.	RESEARCH QUESTIONS.....	4
F.	METHODOLOGY .....	4
G.	LIMITATIONS .....	4
H.	DEFINITIONS .....	5
I.	SIGNIFICANCE OF STUDY .....	5
J.	REPORT OVERVIEW .....	6
K.	CHAPTER SUMMARY.....	7
<b>II.</b>	<b>LITERATURE REVIEW .....</b>	<b>9</b>
A.	CHAPTER OVERVIEW .....	9
B.	STRATEGIC SOURCING .....	10
1.	Overview .....	10
2.	Kraljic’s “Purchasing Portfolio Approach” .....	10
3.	Kraljic’s “Four-stage Approach to Devising Strategy” .....	13
4.	Laseter’s Commodity Sourcing Model .....	14
C.	INDUSTRY ANALYSIS .....	17
1.	Strength, Weakness, Opportunity and Threat (SWOT) Analysis .....	17
2.	Porter’s “Five Forces Model” .....	18
D.	FIRM LEVEL ANALYSIS .....	22
1.	Overview .....	22
2.	Resourced-Based View of the Firm .....	24
3.	Value Chain .....	25
E.	CHAPTER SUMMARY.....	26
<b>III.</b>	<b>CASE STUDY APPLICATION .....</b>	<b>29</b>
A.	CHAPTER OVERVIEW .....	29
B.	BODY ARMOR .....	30
1.	Description of Body Armor.....	30
2.	How Body Armor Works .....	30
3.	Evolutionary History of Body Armor .....	31
4.	Classification .....	33
5.	Body Armor Today .....	35
B.	COMPETITION .....	36
C.	MAJOR PLAYERS IN THE BODY ARMOR MARKET .....	37
1.	Leading Raw Material Suppliers.....	37
2.	Leading Body Armor (Finished Good) Makers .....	39
D.	INDUSTRY STRATEGIES .....	41

E.	FINANCIAL EXAMINATION .....	42
F.	BUYERS .....	47
G.	DISTRIBUTION .....	48
H.	COMPLEMENTS.....	48
1.	Deltoid and Axillary Protectors and Enhanced Side Ballistic Insert .....	49
2.	Land Warrior .....	50
I.	EMERGING TECHNOLOGIES .....	51
1.	Modular Tactical Vests.....	51
2.	Dragon Skin .....	52
3.	Liquid Body Armor .....	53
J.	CHAPTER SUMMARY.....	54
IV.	FINDINGS AND ANALYSIS .....	55
A.	OVERVIEW .....	55
B.	INDUSTRY ANALYSIS .....	56
1.	Threat of Entry (Low) .....	56
2.	Rivalry among Existing Competitors (Low then High).....	58
3.	Threat of Substitutes (Low) .....	61
4.	Bargaining Power of Customers (Low then Moderate) .....	62
5.	Bargaining Power of Suppliers (Low).....	63
C.	FIRM LEVEL ANALYSIS .....	63
D.	CHAPTER SUMMARY.....	67
V.	CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH .....	69
A.	CHAPTER OVERVIEW .....	69
B.	DISCUSSION OF RESULTS .....	69
1.	Realization of Research Questions .....	69
2.	Limitations and Areas of Concern .....	70
C.	KEY RECOMMENDATIONS .....	70
D.	FUTURE RESEARCH.....	71
1.	Effects of Non-market Forces on Military Procurement .....	71
2.	Joint Procurement of Body Armor .....	72
3.	Expanded Evaluation of Strategic Sourcing Methods.....	72
E.	CHAPTER SUMMARY.....	73
	LIST OF REFERENCES.....	75
	INITIAL DISTRIBUTION LIST .....	81

## LIST OF FIGURES

Figure 1.	The Kraljic Matrix: Categories and Recommendations.....	12
Figure 2.	The relationship between traditional SWOT analysis, the resourced based model, and models of industry attractiveness. ....	18
Figure 3.	Porter’s Five Forces Framework.....	19
Figure 4.	The VRIO Framework .....	25
Figure 5.	Generic Value Chain.....	26
Figure 6.	Body Armor Industry Product Flow Diagram .....	41
Figure 7.	Five Year Stock Price Comparison of Leading Body Armor Firms.....	46
Figure 8.	Photos of DAP and ESBI.....	50
Figure 9.	Photo of Land Warrior System. ....	51
Figure 10.	Armor Holdings Value Chain Analysis .....	65

THIS PAGE INTENTIONALLY LEFT BLANK

## LIST OF TABLES

Table 1.	NIJ Armor Classifications for Ballistic-Resistant Armor .....	34
Table 2.	Basic Financial Data Comparison of Leading Body Armor Firms.....	43

THIS PAGE INTENTIONALLY LEFT BLANK

## **ACKNOWLEDGMENTS**

Sincere gratitude goes to our advisors, Lt Col Bryan Hudgens and Dr. Rene Rendon, who provided invaluable guidance and support during this project. Your insight and direction were truly appreciated.



THIS PAGE INTENTIONALLY LEFT BLANK

# **I. INTRODUCTION**

## **A. CHAPTER OVERVIEW**

This chapter of the research report covers the background, problem statement, purpose of study, research question, methodology, limitations, definitions, significance of study and report overview. The objective of this chapter is to create a clear and concise understanding of the research problem, its significance and how the problem will be analyzed. This introduction chapter establishes the foundation upon which the subsequent chapters will be based. It begins with a discussion of the background.

## **B. BACKGROUND**

Implementation of strategic sourcing processes and policies have increased in popularity as both private and public organizations contend with ever-decreasing resources and increasing output expectations.<sup>1</sup> The success of firms using strategic sourcing has been a catalyst for the increased interest by governmental organizations.<sup>2</sup> The use of strategic sourcing and other best practices allows organizations to improve performance and reduce cost by improving the management of existing resources.

Historically, purchasing was thought to be an administrative function and was a separate entity from the remainder of the supply chain.<sup>3</sup> This line of thinking has gradually changed to incorporate purchasing into the supply chain.<sup>4</sup> Firms eventually took notice that material costs were accounting for significant percentages of the cost of goods. Firms recognized that developing strategies to minimize these costs was an effective method to increase profits without a corresponding increase in sales.

---

<sup>1</sup> Robert Monczka, et al., Purchasing and Supply Chain Management, (Mason: South-Western, 2005).

<sup>2</sup> Nancy Y. Moore, et al., Using a Spend Analysis to Help Identify Prospective Air Force Purchasing and Supply Management Initiatives, (Arlington: Rand Corporation, 2004).

<sup>3</sup> Monczka, 4.

<sup>4</sup> Monczka, 24.

The United States Air Force (USAF) has demonstrated considerable interest in strategic sourcing. The USAF has taken strategic sourcing initiatives such as sponsoring acquisition research, developing commodity councils, and announcing pilot efforts to explore regional contracting offices. These initiatives will likely grow in importance as the USAF continues to competitively source and/or privatize many of its non-core activities. Recent reports have shown that the USAF already spends 69 percent of its budget on outsourced goods and services.<sup>5</sup> In addition, the annual budget of the USAF is a recurring candidate for reductions to support other higher priority efforts. Under such circumstances, improved purchasing and supply management will be crucial to procuring quality goods and services at fair and reasonable prices, in order to fulfill mission requirements.

### **C. PROBLEM STATEMENT**

In order to leverage buying power, reduce costs and improve supplier management, the USAF needs to take a strategic approach to acquiring goods and services. Both academic and business literature promotes strategic sourcing as a viable method of minimizing cost and guarding against materials disruptions.<sup>6</sup> In addition, the Office of Management and Budget has required that each agency create strategic sourcing initiatives, monitor the cost savings and reports the results to the Office of Federal Procurement Policy.<sup>7</sup> However, strategic sourcing techniques and processes within the USAF are relatively new and their full benefit has not been realized.<sup>8</sup> Continued efforts by the USAF to integrate strategic sourcing into its acquisition processes will yield further cost savings and other related supply chain improvements. To assist with

---

<sup>5</sup> Moore, vii.

<sup>6</sup> Peter Kraljic, "Purchasing Must Become Supply Management," Harvard Business Review Sep. 1983: 109-117.

<sup>7</sup> Clay Johnson III, "Office of Management and Budget: Implementing Strategic Sourcing Memorandum," 20 May 2005.

<sup>8</sup> Frank Camm, "Strategic Sourcing in the Air Force," Strategic Appraisal: The United States Air and Space Power in the 21<sup>st</sup> Century.

improving the strategic sourcing efforts of the USAF, this research seeks to demonstrate industry analysis using popular techniques. This is important and relevant because conducting an industry analysis is a critical step toward developing an effective sourcing strategy.<sup>9</sup> In addition, by means of the case study method, this research report will provide valuable insight into the commercial body armor industry. This is important because the USAF along with other Department of Defense services have experienced considerable difficulties procuring body armor.

#### **D. PURPOSE OF STUDY**

The purpose of this research report is to provide the United States Air Force's acquisition community with strategies for conducting industry analysis. As a by-product, this research report will provide an industry analysis of the commercial body armor industry. Industry analysis has been identified as one of the important steps in the strategic sourcing process. Industry analysis provides purchasing organizations with valuable information including the strengths and weaknesses of the suppliers/buyers, potential substitutes and the intensity of competition within the industry. In addition, conducting an industry analysis assists with determining the competitive dynamics and key drivers within a given industry. This information can be utilized to improve an organization's position within a given industry. Equipped with the knowledge provided by a detailed industry analysis, an organization can make better informed decisions concerning their sourcing strategy.

---

<sup>9</sup> Timothy M. Laseter, Balanced Sourcing: Cooperation and Competition in Supplier, (San Francisco: Booz-Allen & Hamilton Inc., 1998).

## **E. RESEARCH QUESTIONS**

In this report, the research team seeks to provide the tools to answer the following questions: What analysis should the USAF utilize to understand the competitive dynamics and key drivers within the industry? How can the information gained from conducting an industry analysis be used to benefit the USAF?

## **F. METHODOLOGY**

This research project shall utilize the case study methodology as the primary means for reviewing industry analysis techniques and providing an in-dept examination of the body armor industry. The case study method was determined the most appropriate research strategy because it allows for the investigation of single high interest approach to a problem within a real-life context. The research data, which includes both academic and market data, was collected using a combination of methods including literature reviews, telephone questionnaires of procurement officials and company representatives, various governmental/commercial reports, newspaper and magazine articles, trade journal and recently published annual reports.

## **G. LIMITATIONS**

The scope of this research is relatively narrow when compared to the size of the strategic sourcing and industry analysis fields. This research report focuses on the most popular frameworks that best address the specific requirements of the USAF. The research team acknowledges that other frameworks exist that may better suit the specific requirements of an organization; however, this research project takes a broader approach to address the research questions.

## H. DEFINITIONS

Throughout this report, several terms will be used repeatedly. They are defined here to ensure a common understanding.

Strategic sourcing: is the process of taking a strategic approach to the selection of suppliers—an approach that is aligned with the organization’s competitive strategy.<sup>10</sup> The Office of Management and Budget defines strategic sourcing as the collaborative and structured process of critically analyzing an organization’s spending and using this information to make business decisions about acquiring commodities and services more effectively and efficiently.<sup>11</sup>

Industry analysis: is the process of exploring the environmental factors in which a firm or organization competes for supplies or services.<sup>12</sup>

Firm-level analysis: examines the actions and resources a firm utilizes to sustain a competitive advantage.<sup>13</sup>

Body Armor: Vests that are augmented with steel, titanium, ceramic, or polyethylene plates to provide additional protection to vital areas.<sup>14</sup>

## I. SIGNIFICANCE OF STUDY

Strategic sourcing and industry analysis has become more important to the USAF because of budget cuts and increased scrutiny on spending practices. The USAF’s budget has decreased in recent years and forecasts predict the trend to continue. Appropriated funds are being diverted from the USAF to support the war efforts in both Iraq and

---

<sup>10</sup> Rene G. Rendon, Commodity Sourcing Strategies: Supply Management in Action, (Monterey: Naval Postgraduate School, 2005).

<sup>11</sup> Johnson, 1.

<sup>12</sup> Laseter, 69.

<sup>13</sup> Jay Barney and Patrick Wright, “On Becoming a Strategic Partner: The Role of Human Resources in Gaining Competitive Advantage,” Human Resources Management, Spring 1998: 37.

<sup>14</sup> United States, Department of Justice, Selection and Application Guide to Personal Body Armor, (Rockville: The National Institute of Justice, 2001).

Afghanistan. The budget reductions have forced the USAF to do more with less; thus effective purchasing practices have become an imperative. In addition to the budget reductions, the Department of Defense is experiencing increased scrutiny of its acquisition processes. General Accounting Office (GAO) and other auditing agencies have published reports stating various problem and/or inefficiencies with Department of Defense acquisitions.<sup>15</sup> The problems are many; however, one of the problems investigated by the GAO and Congress was the acquisition of body armor.<sup>16</sup> The negative attention created by the body armor debacle, was one of the catalyst for the Department of Defense's mandate to its acquisition communities to begin conducting in-depth market research and develop sourcing strategies that were both economical and feasible. This research report will assist the USAF with implementing strategic sourcing strategies that will reduce cost and satisfy governing requirements.

## **J. REPORT OVERVIEW**

Using the case method approach, this research seeks to identify viable methodologies for conducting industry analysis. The research team's methodology for accomplishing this goal is to first conduct a literature review. The literature review, which is chapter II of the research report, will provide valuable information on both strategic sourcing, industry analysis and firm-level analysis. However, more importantly the literature review will provide an overview of the most popular methodologies for conducting an industry analysis. In Chapter III, a case study of the United States' body armor industry will be presented. The body armor industry was selected as the topic of the case study because of its potential for strategic sourcing and the many problems associated with its acquisition by the USAF and other Department of Defense services. The ultimate goal of the case study is to provide an example on to which the various industry analysis techniques discovered from the literature review can be applied. In

---

<sup>15</sup> United States, Government Accountability Office, Defense Logistics: Actions Needed to Improve the Availability of Critical Items during Current and Future Operations (Washington D.C.: GAO, 2005).

<sup>16</sup> Government Accountability Office, Defense Logistics.

Chapter IV, the research team examines the industry using the methods revealed in the course of the literature review. It is believed that using the industry analysis models, a buying organization could accurately assess any given industry and use this information to assist in determining the most appropriate sourcing strategy. In Chapter V, the research report provides a conclusion discussion. This discussion includes the challenges of applying the various industry analysis models from the perspective of the USAF. In addition, this chapter will also present recommendations and areas for further research.

## **K. CHAPTER SUMMARY**

This chapter provides the foundation upon which the subsequent chapters will be based. In this chapter, the background, purpose of the study, research question, problem statement, methodology, limitations, definitions, and significance of the study were all discussed. The objective of this discussion was to provide a sufficient level of understanding of the subject research and its importance. The expected outcome of this research is a published MBA project offering a methodology for conducting an industry analysis of a given marketplace. In addition, this MBA project will provide a case study application to highlight challenges, considerations and lessons learned for the procurement of body armor.



THIS PAGE INTENTIONALLY LEFT BLANK

## **II. LITERATURE REVIEW**

### **A. CHAPTER OVERVIEW**

This chapter provides relevant and important background information in the areas of strategic sourcing, industry analysis, and firm-level analysis. A thorough review of these areas is critical to identifying and applying the analytical tools necessary to conduct an industry analysis. In addition, the findings and analysis chapter of this report will be based on the frameworks discussed in this chapter. The scope of the subject literature review is relatively narrow, focusing on several key factors and their respective sub-factors.

This chapter begins with a review and summary of information relating to the strategic sourcing process. This area of research is expansive and covers numerous topics including supply chains, supplier relationships, and strategic analysis techniques. However, this report will only discuss the topics that were determined most relevant to the research problem.

The literature review then discusses the prominent theories used to analyze markets and industries. The review of this literature provides methods for analyzing environmental threats and opportunities. Next, the literature review will provide perspectives on evaluating individual firm's strengths and weakness. Included in this discussion will be analytical tools that can be used to assess a firm's internal opportunities and challenges.

The subject research will be conducted from the perspective of the United States Air Force; thus, topics not relevant to public sector procurement may only receive a cursory review. On the other hand, because the experience of industry informs both the academic and practitioner literatures on industry analysis, this study frequently discusses "firms", meaning for-profit ventures, rather than "organizations", which can include not-for-profit and governmental ventures. Ultimately, the goal of this research is to provide the United States Air Force with a methodology for conducting an industry analysis.

## **B. STRATEGIC SOURCING**

### **1. Overview**

The philosophy of strategic sourcing has gained in popularity and appeal as both private and public organizations contend with ever-decreasing resources and increasing output expectations.<sup>17</sup> The success of commercial firms using strategic sourcing has been the catalyst for the increased interest by government organizations. The use of strategic sourcing and other best practices allows organizations to improve performance and save money by improving on the management of existing resources.

Historically, purchasing was thought to be an administrative function and was separated from the supply chain.<sup>18</sup> This line of thinking has gradually changed to incorporate purchasing into the supply chain. Firms eventually took notice that material costs were accounting for upwards of 60 to 70 percent of the cost of goods.<sup>19</sup> Developing strategies to minimize these costs would increase a firm's profits.

A review of the literature found many strategic sourcing models. The strategic sourcing models discovered during this review ranged from those that were developed for specific organizations to those developed as general guides. The majority of the models studied shared many of the same processes and characteristics; in some instances only the titles to the steps changed. In this chapter, several of the more common and representative frameworks will be reviewed.

### **2. Kraljic's "Purchasing Portfolio Approach"**

The Kraljic Purchasing Portfolio Approach provides useful tools for determining an appropriate sourcing strategy for a specific product or service.<sup>20</sup> The model is based

---

<sup>17</sup> Moncka, 170.

<sup>18</sup> Moncka, 5.

<sup>19</sup> Moncka, 6.

<sup>20</sup> Kraljic, 112.

on two factors; the importance of the purchase and the complexity of the supply markets. Given these two inputs, the model suggests the most appropriate purchasing strategy for the item (see Figure 1).

The Kraljic Purchasing Portfolio Approach groups procurements into four categories, each having different strategic implications. Those categories with their associated strategies are Leverage (Materials Management), Noncritical (Purchasing Management), Strategic (Supply Management) and Bottleneck (Sourcing Management).<sup>21</sup>

Leverage items are those items for which the importance of the purchase is high; however, the complexity of the supply markets is low. For items that fall into this category, Kraljic suggest that the buying organization utilize an approach that exploits the organization's purchasing power. This would include consolidating multiple purchases into a single buy. For example, a printing company may consider paper a leverage item because its impact on profit is considerable and the supply risk is low.

Items that fall into the Noncritical category are characterized as having low importance and noncomplex supply markets. The procurement strategy for noncritical items is purchasing management. The purchase management strategy seeks to establish efficient processing. The products involved in this category are those that are readily available in the marketplace. Suppliers should be selected on their ability and willingness to reduce the cost of logistics.<sup>22</sup>

Strategic items are viewed to be highly important and originate from highly complex supply markets. For strategic items, Kraljic suggests a strategy in which an organization diversifies, balances or exploits its position in the industry. When developing strategy to procure strategic items, one of the primary goals is to establish long-term availability. Within the Department of Defense, major weapon systems are considered strategic items. Major weapon systems are both highly important to the Department of Defense and have highly complex supply markets.

---

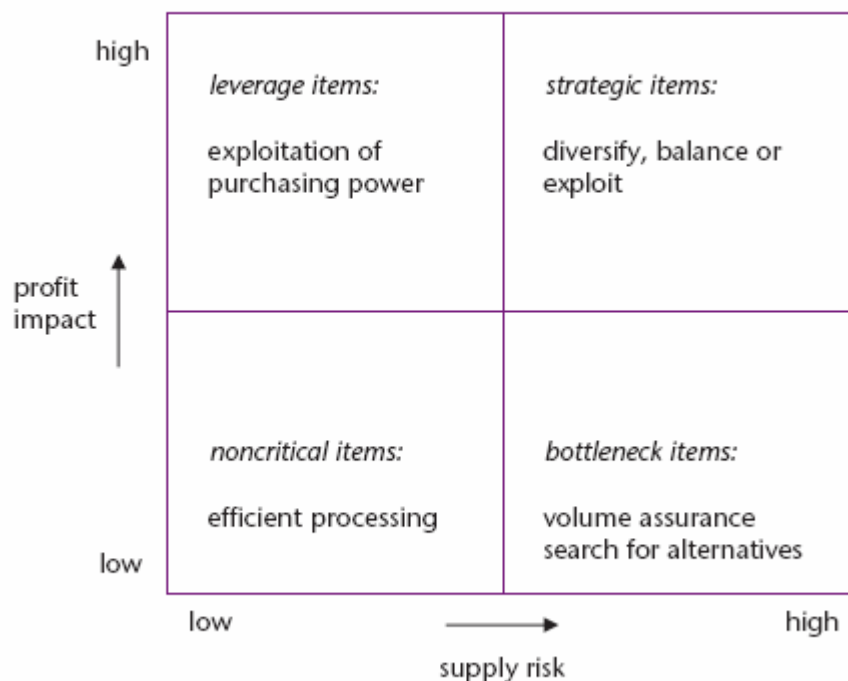
<sup>21</sup> Kraljic, 112.

<sup>22</sup> Dirk-Jan F.Kamann, "The Strategic Value of Proper Purchasing," Management Clout.

Lastly, the Bottleneck category is defined as having low importance but the complexity of their supply market is high. When procuring bottleneck items, the organizations should focus on volume assurance and search for alternative. For example, the Department of Defense could consider body armor as a bottleneck item. From a financial perspective, body armor constitutes small percentage of the Department of Defense budget; however, its procurement is relatively complex.

In addition to providing insight on the most effective manner to conduct purchases, the model also states that the category in which a purchase is classified dictates the level and complexity of the market analysis required.<sup>23</sup> Ultimately, the Kraljic approach can assist with the development and implementation of sourcing strategies for a variety of outsourced items.

#### THE KRALJIC MATRIX: CATEGORIES AND RECOMMENDATIONS



*Source: Modified from Kraljic (1983).*

Figure 1. The Kraljic Matrix: Categories and Recommendations<sup>24</sup>

<sup>23</sup> Kraljic, 112.

<sup>24</sup> Kraljic, 112.

### **3. Kraljic's "Four-stage Approach to Devising Strategy"**

Peter Kraljic also developed a simplified methodology that allowed companies to minimize their supply vulnerabilities and maximize their buying power.<sup>25</sup> This four-stage approach incorporates the Purchasing Portfolio Approach discussed above. During the first phase, which is termed classification, the company classifies all of its purchases in terms of profit impact and supply risk.<sup>26</sup> Profit impact can be viewed in terms of the influence a supply item has on the growth of the business or quality of the product. Supply risk is analyzed in terms of the likelihood supply chain disruptions will occur; taking into consideration environmental factors such as the number of suppliers and competitive demands. Using these criteria, purchases are classified as one of the following: Strategic (high profit impact, high supply risk), Bottleneck (low profit impact, high supply risk), Leverage (high profit impact, low supply risk), and Non-critical (low profit impact, low supply risk).<sup>27</sup> Each of these categories requires different sourcing strategy and levels of analysis. For example, strategic purchase decisions may require the use of more extensive analytic techniques including in-depth market analysis, risk analysis, and computer simulations. In contrast, for those purchases classified as non-critical, simple market analyses may be sufficient for support of decision. Due to the dynamic nature of most industries, it is important to regularly update these classifications.

The second phase in Kraljic's sourcing strategy is called market analysis. The purpose of the market analysis phase is to determine the relative strengths and weaknesses of the suppliers. During this phase a company is tasked with exploring such factors as suppliers' capacity utilization, uniqueness of supplier's product, annual volume purchased and expected growth in demand, and potential costs in the event of nondelivery or inadequate quality.<sup>28</sup> A thorough analysis of the market should provide the company with a good understanding of the market including its key drivers, thereby creating the ability to gauge the feasibility of obtaining the supplies it requires.

---

<sup>25</sup> Kraljic, 112.

<sup>26</sup> Kraljic, 112.

<sup>27</sup> Kraljic, 112.

<sup>28</sup> Kraljic, 113.

Strategic positioning is the third phase in the Kraljic framework.<sup>29</sup> Strategic positioning utilizes the purchasing portfolio matrix to compare the strengths of the purchaser against the strengths of the suppliers. In situations where the buyer has considerable strength relative to the supplier, the model suggests an aggressive strategy (exploit) be utilized. This strategy is deemed appropriate for this situation because the buyer obtain higher profits via favorable pricing and contract agreements. It is important to note that buyer should not act too aggressively, whereby the actions harm long-term relationships or provoke counter actions. In markets where the suppliers are strong relative to the buyers, a more defensive approach (diversify) is recommended. The diversification approach limits the buyer's vulnerability to the supply market by incorporating substitutes and new suppliers into the supply chain. Lastly, when the power of the buyer and supplier is approximately equal a well-balanced intermediate strategy is recommended. Kraljic argues utilizing a well-balanced intermediate strategy when a defense posture is over-conservative and aggressiveness damages supplier relations.<sup>30</sup>

The fourth phase of the Kraljic sourcing model is the actions plan phase. In this phase, the company formulates the strategic sourcing plan given the information from the previous three phases. The end product of this phase will be documented strategies for obtain supplies at the price, quality and time that is desired.

#### **4. Laseter's Commodity Sourcing Model**

Timothy Laseter created a more rigorous plan for developing and documenting a strategic sourcing strategy. Laseter's plan for creating a sourcing strategy, which is called a commodity business plan, includes seven elements.<sup>31</sup> These elements are: documentation of spending, industry analysis, explanation of cost and performance drivers, segmentation of supplier roles, prioritization of business processes, quantification

---

<sup>29</sup> Kraljic, 113.

<sup>30</sup> Kraljic, 114.

<sup>31</sup> Laseter, 69.

of opportunity and development of an action plan for implementation.<sup>32</sup> The first three elements outline what is known about purchasing situation and provides the basis for decision making. The next three elements define the sourcing strategy based on the information discovered in the first three elements.

The first element of the commodity business plan is documentation of spending, known as a spend analysis. This element involves determining the total amount of purchases for a given product throughout an organization. Laseter notes that this could be a challenging task considering the enormous size and geographic span of some organizations, and recommends that spend analysis be multidimensional, examining purchasing by business units, buying locations, suppliers, and sub-commodities.<sup>33</sup> In September 2004, GAO identified spend analysis as a best practice. The GAO report stated that purchasing organizations could use spend analysis to help them take a more strategic approach to procurement.<sup>34</sup> A Rand report noted that private firms place high importance on spend analysis; 80 percent of supply chain executives in a recent survey viewed a spend analysis as “very important” or “critical” to the success of their enterprise.<sup>35</sup> A thorough spend analysis identifies not just opportunities for savings and performance improvement but also some of the risks that may be associated with using innovative purchasing practices.<sup>36</sup> One of the challenges of using spend analysis is the need to balance potential improvements with socioeconomic and other goals.

The second element of the commodity business plan calls for an industry analysis.<sup>37</sup> The purpose of industry analysis is to provide a thorough examination of the supply industry. To accomplish this, industry analysis seeks to answer questions

---

<sup>32</sup> Laseter, 69.

<sup>33</sup> Laseter, 71.

<sup>34</sup> United States, Government Accountability Office, Best Practices: Using Spend Analysis to Help Agencies Take a More Strategic Approach to Procurement (Washington D.C.: GAO, 2004).

<sup>35</sup> Moore, vii.

<sup>36</sup> Moore, vii.

<sup>37</sup> Laseter, 74.



concerning the power of the customers and suppliers, the level of competition within the industry, and the threats of substitution and new entrants. Laseter recommends the use of Porter's Five-Forces model to accomplish this task.<sup>38</sup>

The third element is the explanation of cost and performance drivers. This section of the plan seeks to build an understanding of the cost and what drives the cost for a particular industry.<sup>39</sup> This section of the plan should include a detailed examination of the manufacturing process because of the insight it provides and its importance in price determinations.

The fourth element of the commodity sourcing plan is segmentation of supplier's roles; this element is the first to address actual strategy.<sup>40</sup> The objective of this activity is to segment suppliers based on their respective roles and the drivers for their respective segments. Its implication is that different strategies may be required depending on the segment and cost drivers for that segment. This activity provides an organization the flexibility required to maximize its efficiency.

The fifth element of the commodity sourcing plan is the business process prioritization.<sup>41</sup> This element defines the critical areas for supplier integration. This element is a key to discovering opportunities for improvement such as eliminating low-value activities. During this element, make versus buy decisions are analyzed and evaluated.

The sixth element of strategy in the commodity business plan is the quantification of opportunity. This is the documentation of potential savings or improvements. The quantification of an activity should be viewed in terms of dollars. Laseter refers this as proof of a well-done strategy.<sup>42</sup> An action plan is seventh step in the development of rigorous sourcing strategy. An ideal implementation plan highlights the activities, resources, and milestones for accomplishing the goals of the strategy.<sup>43</sup>

---

<sup>38</sup> Laseter, 74.

<sup>39</sup> Laseter, 77.

<sup>40</sup> Laseter, 79.

<sup>41</sup> Laseter, 82.

<sup>42</sup> Laseter, 84.

<sup>43</sup> Laseter, 86.

Industry analysis is an integral aspect of developing an effective sourcing strategy, and figures prominently in both the Kraljic and Laseter models. The following section will discuss two of the leading industry analysis models.

## **C. INDUSTRY ANALYSIS**

### **1. Strength, Weakness, Opportunity and Threat (SWOT) Analysis**

SWOT analysis provides a valuable framework for providing strategic insight into an industry.<sup>44</sup> SWOT analysis seeks to analyze an industry from the perspective of examining the industry's strengths, weaknesses, opportunities, and threats.<sup>45</sup> Ideally, SWOT analysis highlights how strengths may be leveraged to realize opportunities and how threats and weaknesses can be overcome.<sup>46</sup> The strengths of an industry are those resources and capabilities that provide some level of competitive advantage. On the opposite end of the spectrum, weaknesses are those obstacles that interfere with the firm's ability to realize economic value. Opportunities are the opening within the market place that allows a firm to improve its competitive position. Threats are those elements within the industry or outside the industry that deliberately or not deliberately seek to reduce a firm's performance.

---

<sup>44</sup> E.K. Valentin, "SWOT Analysis from A Resource-Based View," *Journal of Marketing Theory and Practice* Spring 2001: 54-69.

<sup>45</sup> Valentin, 54.

<sup>46</sup> Valentin, 54.

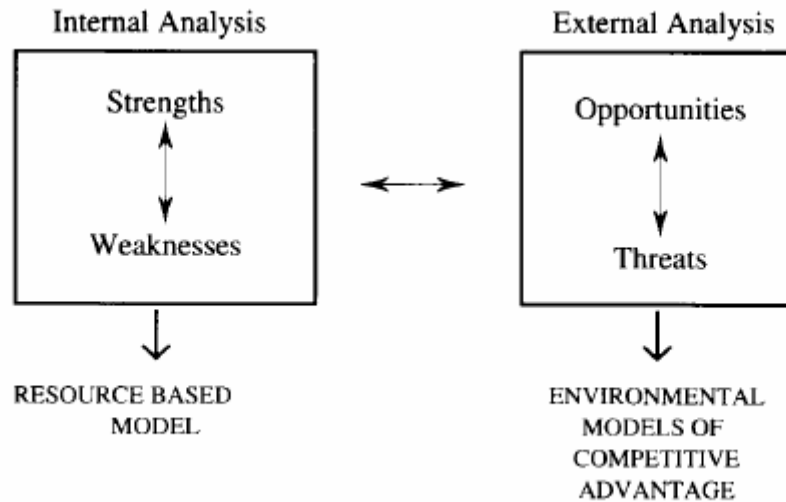


Figure 2. The relationship between traditional SWOT analysis, the resourced based model, and models of industry attractiveness.<sup>47</sup>

## 2. Porter's "Five Forces Model"

A widely used framework in the strategic analysis of industry economics was developed by Michael E. Porter.<sup>48</sup> Porter's Five Forces Framework attempts to take into account all the factors that have a bearing on a particular industry economics. Porter identified these forces as threat of new entrants, rivalry among existing competitors, threat of substitutes, bargaining power of suppliers and bargaining power of customers.<sup>49</sup> Additional industry forces have been added to the framework by other researchers. Critical analysis of the economic forces allows firms to better understand the market place dynamics and the key drivers of profitability and sustainability.

<sup>47</sup> Jay Barney, "Firm Resources and Sustained Competitive Advantage," Journal of Management 1991: 99-120.

<sup>48</sup> Michael E Porter, Competitive Advantage: Creating and Sustaining Superior Performance, (New York: The Free Press, 1985).

<sup>49</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 5.

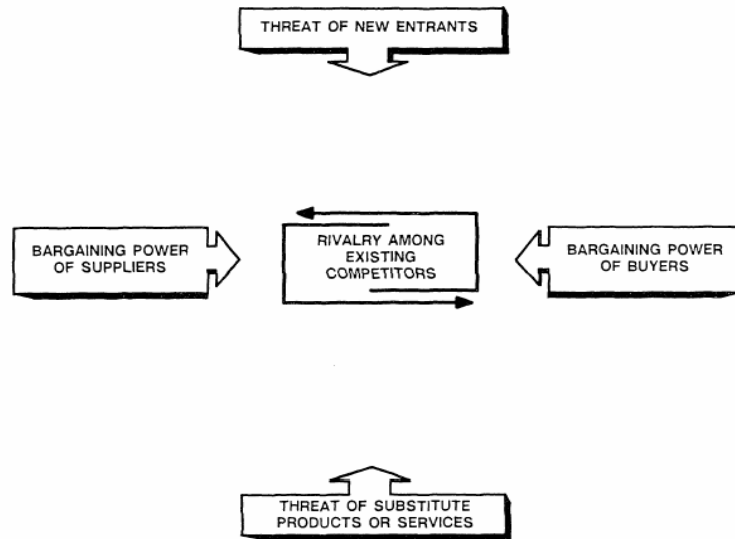


Figure 3. Porter's Five Forces Framework<sup>50</sup>

From a practical standpoint, Porter's Five Forces Framework allows users to begin to address important questions relating to their respective industries. Industry identification is a key area that is assessed during the process of constructing the model. Industry identification is critical because it starts the process of thinking about the space which a particular firm competes. Furthermore, it aids in establishing the boundaries of the industry which is to be analyzed. Failure to create boundaries would result in an analysis that was overly broad in scope and thus not useful. Proper application of the model facilitates the answering of numerous analytical questions. Perhaps one of the most significant questions is: who is the industry leader and why? Answering the why to the previously posed question is one of the keys to understanding profitability and sustainability for an industry. Another byproduct of analyzing an industry from the perspective of the Five Forces Model is that it provides insight to the level of competition and the effect competition has on capturing value. Lastly, application of the model fosters an analytical process in which critical evaluation and forecasting concerns are addressed. The framework facilitates the identification of the key economic drivers within the industry. This allows firms to note what is important within their given

<sup>50</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 6.

industry in regards to profitability and then create strategies to attempt to take advantage of the identified driver. Porter's Five Forces Framework also enables analysts to predict changes within the industry. Porter's Five Forces Framework creates an analytical process which fosters the answering of the aforementioned concerns and many others. A discussion of the individual forces which comprise Porter's framework follows.

**Threat of New Entrants:** The first force in Porter's Five Forces Framework is the threat of new entrants.<sup>51</sup> The threat of new entrants is considered a serious threat to profitability and sustainability. This is due to the idea that as competition increases (more firms enter the market), profitability decreases. Increased competition has a tendency to increase cost and decrease prices or market share. Costs are increased due to an increase in the power of both the suppliers and the buyers. With increased competition, both buyers and sellers have more options of firms with whom to conduct business with and thus can demand more favorable terms.

A factor to consider when evaluating the threat of new entrants is the industry's barriers to entry. Entry barriers can either be structural (capital intensive) or strategic (e.g., retaliation, shelf space, increased marketing). The following factors tend to raise the barriers to entry into a market: economies of scale, differentiation, capital requirements, switching cost, access to distribution, expected retaliation and government policy.<sup>52</sup> Ultimately, incumbents prefer high barriers to entry because they make it unprofitable for new entrants to enter the market and thus allow for above average profits.

**Rivalry among existing competitors:** Although briefly mentioned above, rivalry among existing competitors has an enormous bearing on industry conditions. Of course, there are industries where little to no competition exist; in such circumstances the firms exert monopolistic type power. However, in most industries there is some level of competition. The level of competition amongst firms within an industry is dependent upon the condition of the given industry. Some factors that have a tendency to increase competition are high stakes, low switching cost, high fixed costs, slow growth, and high

---

<sup>51</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 5.

<sup>52</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 6.

exit barriers. Firms have various means to respond to competitive acts taken by their rivals. In some industries rivals respond to each other's actions by introducing new products or new marketing campaigns. Yet in other industries competitors engage in "price wars". Understanding the rivalry amongst existing competitors and the key drivers to this competition is important to understanding the overall market condition.

**Threat of Substitutes:** From the perspective of the firm, the threat of substitute products is always looming. For any given product or service, the list of potential substitutes is expansive. Substitutions can come in many different forms: different product or service, used vs. new products, rental vs. purchase, complement substitution, downstream substitution, no purchase, or less consumption. The threat of substitution could also restrict a firm's activities by placing price ceilings on a firm's products. If a firm exceeded the given price customers would readily switch to the substitute. The area of substitutes is difficult to assess because the substitutes could be subtle and unexpected; for example, video-conferencing vs. air travels. Lastly, the triggers or potential triggers to substitution could be incorporated into the analysis of the industry. Some of the events that trigger substitution are technological change, deregulation or changes in customer preferences. When assessing the magnitude of the substitution threat several key factors should be considered: relative value, relative price, buyer switching cost, and buyer propensity to substitute.<sup>53</sup> The threat of substitution is reduced when the magnitude of these factors is greater.

**Bargaining Power of Suppliers and Buyers:** The power of a firm's suppliers and customers is another important factor that must be considered when conducting industry analysis. Suppliers utilize bargaining power by raising prices or reducing quality of goods or services for buyers. Whereas, buyers assert bargaining power by forcing down prices, demanding higher quality and pitting competing suppliers against one another.<sup>54</sup> Some of the conditions that increase the power of buyers are

---

<sup>53</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 6.

<sup>54</sup> Michael E. Porter, Competitive Strategy: Techniques for Analyzing Industries and Competitors, (New York: The Free Press, 1980).

undifferentiated products, low switching cost, threat of backwards integration and low profit margins. A few factors that increase the bargaining power of the suppliers are few suppliers, no substitutes, supplier's inputs are critical, and high switching cost.

## **D. FIRM LEVEL ANALYSIS**

### **1. Overview**

Equipped with a firm understanding of the industry, an individual firm's strategy and competitive advantages can now be examined. The analysis of individual firms and their respective standings within the industry is important because it works to answer one of many research questions. Modern strategic theory holds that for a firm's strategy to be successful it must exhibit external, internal and dynamic consistencies.<sup>55</sup> External consistency is shown when both a firm's strategy and activities are congruent with the industry.<sup>56</sup> This means that a firm has the correct plan and is taking the appropriation actions to successfully take advantage of environmental opportunities and counter environment threats. Internal consistency is a situation where the activities of the firm move toward successfully fulfilling a firm's strategy.<sup>57</sup> Organizations often state that they have a particular strategy; however, the activities of these firms show otherwise. Various literatures have also shown internal consistency in the form of an activity system.<sup>58</sup> The activity systems demonstrated how procurement, manufacturing, marketing and distribution all related and reinforced each other. A firm has dynamic consistency when it is taking the required actions today to succeed tomorrow.<sup>59</sup>

In addition to showing consistency, a firm's strategy must also create value. The total value created by a firm is the difference between the customer's willingness to pay and the supplier's willingness to sell. The value that is captured by the firm is the

---

<sup>55</sup> Michael E. Porter, "Toward a Dynamic Theory of Strategy," Strategic Management Journal, Winter 1991: 95-117.

<sup>56</sup> Porter, "Toward a Dynamic Theory of Strategy," 97.

<sup>57</sup> Porter, "Toward a Dynamic Theory of Strategy," 102.

<sup>58</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance.

<sup>59</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance.

difference between the price of the items and its cost to the firm.<sup>60</sup> The total value captured by the customer is the difference between its willingness to pay and the price of the item.

From a very generic perspective there are two types of competitive advantage. The two types of competitive advantages are differentiation and low-cost. A differentiation strategy attempts to capture value by increasing the customer's willingness to pay. A consequence of this strategy is that costs are generally higher than its competitors. A low-cost strategy fights to capture value by lowering the cost. Wal-Mart is an excellent example of a firm that utilizes a low-cost strategy. In some situations firms may exhibit a dual advantage. This is a situation where a firm has lower cost and a higher willingness to pay than its competitors.

Another important consideration to a firm's strategy is its competitive scope. A firm's competitive scope is generally characterized as broad or narrow; however, there is a lot of gray area between the two.

Creating a competitive advantage is difficult; however, sustaining a competitive advantage is far more challenging. The five classes of threat to sustainability have been identified as imitation, substitution, saturation, holdup and slack.<sup>61</sup> Imitation is an attempt to duplicate products or processes of competitors. Substitution is the process by which one product replaces another in performing a particular function for the buyer.<sup>62</sup> Saturation occurs when supply for a given product within a given industry exceeds demand of buyers. Holdup threatens a product's sustainability because it creates a dependence on the continued cooperation of complements.<sup>63</sup> Slack is concerned with the capability of organization efficiency manage internal processes and procedures to capture all potential value. The literature suggests strategies to respond to the threats. For example, a suggested response to imitation is building barriers. A firm can build barriers via economies of scale and scope, upgrading or threats of retaliation. Some suggested

---

<sup>60</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance.

<sup>61</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 267.

<sup>62</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 273.

<sup>63</sup> Pankaj Ghemawat and Gary Pisano, "Sustaining Superior Performance: Commitments and Capabilities," Harvard Business School, July 1997: 1-20.



responses to saturation are disinvestment, expansion, entering new markets and introducing product upgrades. Responses to substitution include fighting, switching and not responding. Organizations the encounter problems related to slack should take the following actions: offer performance incentives, monitor behavior and/or shape norms. Some responses to holdup are building bargaining power, building relationships and developing trust.

## **2. Resourced-Based View of the Firm**

A tool for analyzing the strengths and weaknesses of a firm is the Value, Rareness, Imitability and Organization (VRIO) framework.<sup>64</sup> This type of analysis attempts to describe how the internal resources of a firm affect its performance. The VRIO provides a unique perspective by focusing on the elements of a firm that are valuable, rare, imitable, and which the firm is organized to exploit.<sup>65</sup> Moreover, the framework helps illustrate what internal resources contribute to developing and sustaining a competitive advantage. A firm creates value through decreasing cost or differentiating its products in such a way that allows a premium price. Valuable assets include those that allow a firm to respond to threats/opportunities. Rare resources are those that allow a firm to enjoy a competitive advantage because other firms do not possess the resource. Moreover, for a resource to maintain a sustained competitive advantage the rarity of the resource must endure over time. A firm also enjoys a competitive advantage if its valuable resources are difficult to imitate or substitute. Some barriers to imitation include, legal restrictions, market size and scale of economies, and intangible barriers. Last the framework, organization, looks at whether firms are organized in such a manner to exploit the resources it owns. Performing firm-level analysis using the VRIO framework on firms of interest aids with developing and understanding of the industry. Understanding what gives a firm a competitive advantage ties directly to the dynamics and key drivers of an industry.

---

<sup>64</sup> Jay Barney and Patrick Wright, "On Becoming a Strategic Partner: The Role of Human Resources in Gaining Competitive Advantage." Human Resources Management, Spring 1998: 37.

<sup>65</sup> Barney, "On Becoming a Strategic Partner."

### Is a Resource...


Valuable?	Rare?	Difficult to Imitate?	Supported by Organization?	Competitive Implications	Performance
No	----	----		Competitive Disadvantage	Below Normal
Yes	No	----		Competitive Parity	Normal
Yes	Yes	No		Temporary Competitive Advantage	Above Normal
Yes	Yes	Yes		Sustained Competitive Advantage	Above Normal

Figure 4. The VRIO Framework<sup>66</sup>

### 3. Value Chain

Another tool used to perform firm-level analysis is the value chain. The value chain provides a systematic way of examining all the activities a firm performs and how those activities interact to create a competitive advantage.<sup>67</sup> It is argued that competitive advantage cannot be understood by simply looking at the firm as a whole; an analyst must investigate the many discrete activities a firm performs.<sup>68</sup> The value chain is a tool that facilitates such an examination.

Although value chains within the same industry may differ depending on the respective firm's strategy; all value chains are composed of 9 generic categories of activities, which are all linked.<sup>69</sup> The activities are divided into two groups, primary activities and support activities. The primary activities are: inbound logistics, operations, outbound logistics, marketing and sales, and service. The support activities include firm infrastructure, human resources management, technology development and procurement.

<sup>66</sup> Barney, "On Becoming a Strategic Partner."

<sup>67</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 33

<sup>68</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 33.

<sup>69</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 34.

Both primary and support activities can be further defined into sub-activities. Each category may be important to a firm's competitive advantage depending on the industry.

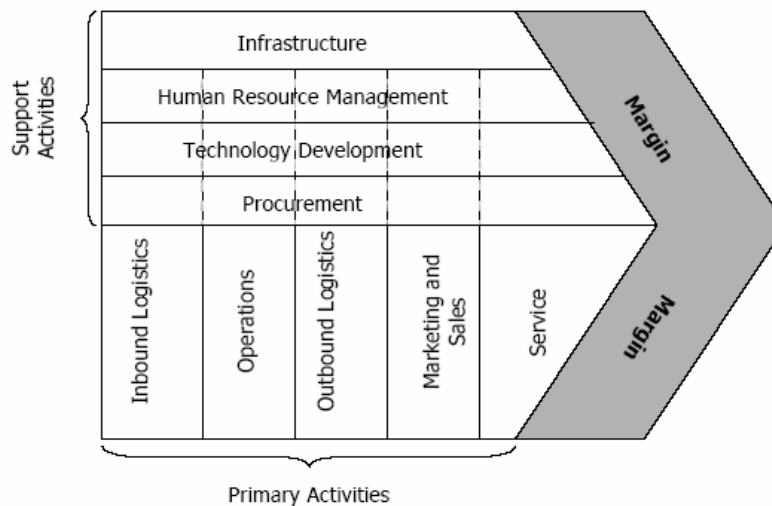


Figure 5. Generic Value Chain<sup>70</sup>

The value chain is composed of value activities and margin which adds up to be the total value. The margin is the difference between the total value and the cost to perform the value activities. The value chain tool helps reinforce the idea that competitive advantage is due to a collection of interdependent activities.

## E. CHAPTER SUMMARY

The purpose of this chapter was to highlight the relevant literature important to the subject research report. The literature review began with an overview of strategic sourcing and some of the most prominent sourcing frameworks. A critical element to development of a strategic sourcing plan is conducting an industry analysis. This literature review examined various methods for conducting an industry analysis such as SWOT analysis and Porter's Five-Forces. The VRIO framework and Value Chains were

<sup>70</sup> Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 35.

also discussed to provide a tool for firm level analysis. The information found during the course of the literature will form the foundation for the remainder of the research report.

THIS PAGE INTENTIONALLY LEFT BLANK

### **III. CASE STUDY APPLICATION**

#### **A. CHAPTER OVERVIEW**

The purpose of the case study application is to look inside a particular industry or event, break it apart and study its distinctive characteristics. In this case, the goal is to gain an understanding of how to utilize strategic sourcing applications and analyze the industry. Basically, this chapter answers the what, why, where, how and who of body armor. Specifically, this chapter examines the body armor industry as it interrelates to the military, specifically the United States Air Force.

This chapter first defines body armor by delving into the historical developments, outlining classifications and governing organizations, describing how it works, and examining manufacturing components and competition. Second, this chapter explores leading body armor firms through employed strategies, financial position and marketing techniques. Third, this chapter looks outside of the organizations to the buyers, distribution process, and suppliers of body armor. Finally, this chapter investigates the complements to body armor and alternative technologies.

Fueled by the Global War on Terrorism (GWOT), the body armor industry has taken the forefront of media attention. The GWOT has reintroduced the rifleman as the predominate offensive system against an elusive threat.<sup>71</sup> Urban conflict places unique dependability on the individual soldier and ultimately his/her safety. And, as soldiers continue to be the most important element of urban operations, body armor procurement costs will continue to increase.<sup>72</sup> Therefore, it is important for government procurement agents like contracting, acquisition and finance personnel to understand and analyze industries like body armor and to research the market to get the most from sparsely stretched fiscal dollars.

---

<sup>71</sup> Gary R. Kramlich II., "The Effects of Posture, Body, Armor, and Other Equipment on Rifleman Lethality," (Thesis, Naval Postgraduate School, 2005), p. xvii.

<sup>72</sup> Robert F. Hahn II and Bonnie Jezior, "Urban Warfare and the Urban Warfighter of 2025," Parameters, Summer 1999, 74.

## **B. BODY ARMOR**

### **1. Description of Body Armor**

Simply stated, armor is a protective covering used in combat, and body armor is armor that protects the wearer's body.<sup>73</sup> However, for the purposes of this report body armor, which is also known by bullet-resistant vest, is an article of clothing that creates a protective barrier around the human torso that minimizes injury from projectiles originating from firearms and other explosive devices. The current USAF standards for body armor consist of soft and hard armor, the Outer Tactical Vest (OTV), combined with two rifle plates called Small Arms Protective Inserts (SAPI).<sup>74</sup> For the purpose of this report, we consider only firms that are capable of making and supplying the USAF standard body armor. Before addressing these standard components in greater detail, it will be helpful to consider the purpose behind body armor.

### **2. How Body Armor Works**

Stopping a bullet is a more complex process than most people realize. To do it with lightweight materials and little space requires a clear understanding of the relevant physics and mechanics. The challenge for body armor designers is to convert a bullet's impact to the equivalent of a blunt (versus piercing) blow. Fundamental conservation laws in physics establish that momentum can not be stopped, but is transferred from the bullet to the person. This makes the role of body armor (or bullet-proof vests) clear—to place protective armor between the person and the bullet so that it does not puncture the person, but rather spreads the momentum from the bullet across the body armor.<sup>75</sup>

---

<sup>73</sup> George A. Miller, "Wordnet, Cognitive Science Laboratory," 20 November 2006 <<http://wordnet.princeton.edu/>>.

<sup>74</sup> United States, Director of Logistics Readiness, Deputy Chief of Staff/Logistics, Installations and Mission Support, Brigadier General Gary T. McCoy, Department of the Air Force Presentation to the Tactical Air and Land Forces Subcommittee Committee on Armed Services United States House of Representatives, (Washington D.C.: 15 June 2006) 2-3.

<sup>75</sup> James D. Walker, Ph.D., "Turning Bullets into Baseballs," Southwest Research Institute Technology Today, Spring 1998: 1.

Body armor must include sufficient material to distort and slow the bullet enough so that, when the momentum reaches the wearer, the bullet impacts like a “baseball” hitting skin. Such impacts bruise and break ribs, but are preferable outcomes to the injury caused by a body penetrating bullet. The challenge is to reduce body armor weight while retaining its ability to stop bullets.<sup>76</sup>

Given the strength of aluminum or steel, people may assume there's an obvious solution—make a garment of those materials to stop the bullets. The amount of material needed to cover a torso with an aluminum or steel vest would weigh up to 50 pounds—clearly unacceptable considering the additional gear also required by soldiers today. However, the idea of lightweight maneuverable body armor is not a new concept. Body armor has played a pivotal role throughout history, and it has evolved toward lighter, more effective means of protection.<sup>77</sup>

### **3. Evolutionary History of Body Armor**

The advent of protective garments dates back to the earliest stages of recorded history. Early humans used animal skins to protect themselves from injury in combat and other dangerous situations. As civilization advanced, wood followed by metal became the material of choice for protective clothing. During the Middle Ages, knights covered themselves in a suit of armor constructed using metallic materials. However, with the development of the firearm, most traditional protective devices were no longer effective. In fact, manmade barriers such as stone or masonry walls; manmade fortifications such as trenches and ditches; or natural barriers, such as rocks and trees, were the only real protection available against firearms.<sup>78</sup>

The medieval Japanese are credited as being the first to use soft armor. Their soft armor was manufactured from silk. By the end of the 19<sup>th</sup> century, an American named Casimir Zeglen, a Polish Priest in Chicago, developed a bullet proof vest made of silk

---

<sup>76</sup> Walker, 1.

<sup>77</sup> Walker, 3.

<sup>78</sup> National Institute of Justice, 3.



fabric in response to the assassination of the city mayor.<sup>79</sup> This development garnered a great amount of attention; even the US military explored the possibility of using soft armor made from silk. However, silk vests had two significant drawbacks. First, the vests were shown to be only effective against low velocity bullets and did not provide any protection against the new generation of bullets which traveled at higher velocities. Second, the cost of soft armor also halted further development; in today's dollars each vest would have cost approximately \$1,500.<sup>80</sup>

Nevertheless, throughout the 20<sup>th</sup> century body armor continued to evolve. The challenges faced by inventors were reducing the weight of the body armor while improving its ability to stop bullets and fragments. The U.S. Patent and Trademark Office lists records dating back to 1919 for various designs of bullet proof vests and body armor type garments. One of the first documented instances of body armor was demonstrated for use by law enforcement officers detailed in the 2 April 1931 edition of the Washington, D.C., Evening Star, where a bullet proof vest was demonstrated to members of the Metropolitan Police Department.

The next generation of anti-ballistic bullet proof vest was the World War II “flak jacket” made from ballistic nylon. The flak jacket provided protection primarily from ammunitions fragments, but was ineffective against most pistol and rifle threats. Flak jackets were also very cumbersome and bulky.

The first fundamentally modern body armor produced for the US military was delivered during the Korean War. During this period, the 24-pound Ranger Body Armor (RBA) was introduced by the U.S. Army Soldier Systems Center.<sup>81</sup> RBA was a vast improvement over its predecessors; although it was still plagued with several critical problems—weight and lack of bullet protection. It was not until the late 1960s that new fibers were discovered that made concealable body armor possible. The National Institute of Justice initiated a research program to investigate development of a lightweight body armor that on-duty policemen could wear full time. The research

---

<sup>79</sup> Scott Simon, “A priest’s Early Quest to Create A Bulletproof Vest,” NPR, Weekend Edition, 30 April 2005 <<http://www.npr.org/templates/story/story.php?storyId=4625858>>.

<sup>80</sup> National Institute of Justice, 3.

<sup>81</sup> Jeff Landis, “Marines Issues Best Body Armor in the World,” The Officer, October 2005: 31.

identified new materials that could be woven into a lightweight fabric with excellent ballistic resistant properties.<sup>82</sup> Less than a decade later, in 1965, one of the most significant achievements in the development of body armor was made. Kevlar, the manmade organic para-aramid fiber, was invented by DuPont scientists Stephanie Kwolek and Herbert Blades.<sup>83,84</sup> The development of Kevlar and ceramic material in the 1970s and 1980s made real “bulletproof” vests possible.<sup>85</sup>

Versions of Kevlar® vests, to include the Personal Armor System-Ground Troops (PASGT) used in Somalia,<sup>86</sup> were standard until in the early 1990s when the Defense Advanced Research Products Agency developed and demonstrated personal body armor inserts (ceramic plates) made of boron carbide. These boron carbide inserts are lighter weight than the previous materials, and combined with Kevlar to create the most modern recognized system of body armor—Army Interceptor Body Armor (IBA).<sup>87</sup> With variety of materials (fibers, plastics, ceramics, etc.) used to make body armor coupled with the wide range of protective capabilities governing organizations created classification standards.

#### **4. Classification**

Underwriters Laboratories and the United States National Institute of Justice (NIJ) establish performance standards. NIJ performance standards plainly specify “a minimum satisfactory level of performance for each attribute that is critical to the equipment’s intended use.” Armor is categorized by the level of protection it provides on a scale from Type I to Type IV. Type I offers the lowest level of protection and Type IV offers the

---

<sup>82</sup> Mary Bellis, “History of Body Armor and Bullet Proof Vests,” June 2005, 10 October 2006 <[http://inventors.about.com/od/bstartinventions/a/Body\\_Armor.htm](http://inventors.about.com/od/bstartinventions/a/Body_Armor.htm)>.

<sup>83</sup> Mary Bellis, “History of Body Armor and Bullet Proof Vests,” June 2005, 10 October 2006 <[http://inventors.about.com/od/bstartinventions/a/Body\\_Armor.htm](http://inventors.about.com/od/bstartinventions/a/Body_Armor.htm)>.

<sup>84</sup> “DuPont Kevlar,” 5 November 2006 <<http://www.dupont.com/kevlar/whatiskevlar.html>>.

<sup>85</sup> “Body Armor History,” 5 November 2006 <<http://www.globalsecurity.org/military/systems/ground/body-armor2.htm>>.

<sup>86</sup> Jeff Landis, “Marines Issue Best Body Armor in the World,” *The Officer*, October 2005: 31.

<sup>87</sup> “Interceptor Body Armor,” 20 January 2006 <<http://www.globalsecurity.org/military/systems/ground/interceptor.htm>>.

highest level of protection. Performance requirements were developed with the active participation of body armor manufacturers. Table 1 describes each armor level and the type of projectiles it protects against as specified by the NIJ.<sup>88</sup>

Table 1. NIJ Armor Classifications for Ballistic-Resistant Armor<sup>89</sup>

Armor Level	Protects Against
<b>Type I</b> (.22 LR; .380 ACP)	This armor protects against .22 caliber Long Rifle Lead Round Nose (LR LRN) bullets, with nominal masses of 2.6 g (40 gr) impacting at a maximum velocity of 320 m/s (1050 ft/s) or less, and .380 ACP Full Metal Jacketed Round Nose (FMJ RN) bullets, with nominal masses of 6.2 g (95 gr) impacting at a maximum velocity of 312 m/s (1025 ft/s) or less.
<b>Type IIA</b> (9 mm; .40 S&W)	This armor protects against 9 mm Full Metal Jacketed Round Nose (FMJ RN) bullets, with nominal masses of 8.0 g (124 gr) impacting at a maximum velocity of 332 m/s (1090 ft/s) or less, and .40 S&W caliber Full Metal Jacketed (FMJ) bullets, with nominal masses of 11.7 g (180 gr) impacting at a maximum velocity of 312 m/s (1025 ft/s) or less. It also provides protection against the threats mentioned in [Type I].
<b>Type II</b> (9 mm; .357 Magnum)	This armor protects against 9 mm Full Metal Jacketed Round Nose (FMJ RN) bullets, with nominal masses of 8.0 g (124 gr) impacting at a maximum velocity of 358 m/s (1175 ft/s) or less, and 357 Magnum Jacketed Soft Point (JSP) bullets, with nominal masses of 10.2 g (158 gr) impacting at a maximum velocity of 427 m/s (1400 ft/s) or less. It also provides protection against the threats mentioned in [Types I and IIA].
<b>Type IIIA</b> (High Velocity 9 mm; .44 Magnum)	This armor protects against 9 mm Full Metal Jacketed Round Nose (FMJ RN) bullets, with nominal masses of 8.0 g (124 gr) impacting at a maximum velocity of 427 m/s (1400 ft/s) or less, and .44 Magnum Semi Jacketed Hollow Point (SJHP) bullets, with nominal masses of 15.6 g (240 gr) impacting at a maximum velocity of 427 m/s (1400 ft/s) or less. It also provides protection against most handgun threats, as well as the threats mentioned in [Types I, IIA, and II].
<b>Type III</b> (Rifles)	This armor protects against 7.62 mm Full Metal Jacketed (FMJ) bullets (U.S. Military designation M80), with nominal masses of 9.6 g (148 gr) impacting at a maximum velocity of 838 m/s (2750 ft/s) or less [provided the projectile hits the hard trauma plate insert]. It also provides protection against the threats mentioned in [Types I, IIA, II, and IIIA].
<b>Type IV</b> (Armor Piercing Rifle)	This armor protects against .30 caliber armor piercing (AP) bullets (U.S. Military designation M2 AP), with nominal masses of 10.8 g (166 gr) impacting at a maximum velocity of 869 m/s (2850 ft/s) or less [provided the projectile hits the hard trauma plate]. It also provides at least single hit protection against the threats mentioned in [Types I, IIA, II, IIIA, and III].

<sup>88</sup> National Institute of Justice, 31-36.

<sup>89</sup> National Institute of Justice, 34-36.

## 5. Body Armor Today

Most modern body armor consists of two primary parts, the protective panel and the carrier. The protective panel is constructed using multiple layers of ballistic materials. The position and number of layers within the protective panel determines the performance of the overall vest. Although the number of layers is critical in the performance of the vest, it is important to note that the fibers/materials play an equally important role. The protective panel is then inserted into the carrier, which is constructed of conventional garment fabrics such as nylon or cotton.<sup>90</sup> The actual design and process used to assemble the bulletproof vest vary between manufacturers. However, if the vest meets or exceeds National Institute of Justice standards, then the user should evaluate options based on fit and comfort and not on designs. The principal products of interest for this report are the Outer Tactical Vest (OTV) and the ceramic Small Arms Protective Insert (SAPI) plates. These two components combined make up the Interceptor Body Armor (IBA), which is the approved style of body armor for the military. IBA offers NIJ Level III protection with the OTV and Level IV protection with the SAPI.<sup>91</sup>

The OTV is made from a vest-shaped sheet of advanced plastics polymers composed of many layers of strong fibers either woven together or coated and bonded with resins and then sealed between two sheets of polyethylene film.<sup>92-93</sup> The SAPI is typically made of boron carbide ( $B_4C$ ) ceramic plate backed with composite ultra-high strength fiber. Boron carbide is the fifth hardest material known behind boron nitride, diamond, ultra-hard fullerite, and aggregated diamond nanorods. It was discovered as bi-product of reactions involving metal borides; it was not until the 1930s that the material was studied scientifically. Boron Carbide is now produced industrially by the carbo-thermal reduction of  $B_2O_3$  (boron oxide) in an electric arc furnace.<sup>94</sup>

---

<sup>90</sup> National Institute of Justice, 16.

<sup>91</sup> Christopher Jenson. "Personal Correspondence" E-mail to USAF/SFXX. 24 January 2006.

<sup>92</sup> "Teijin Twaron," 4 November 2006 <[http://www.dsm.com/en\\_US/html/hpf/home\\_dyneema.htm](http://www.dsm.com/en_US/html/hpf/home_dyneema.htm)>.

<sup>93</sup> Stacey L. Blachford and Thomson Gale, eds., "Bulletproof Vest," How Products are Made, 2002, 17 Oct. 2006 <<http://science.enotes.com/how-products-encyclopedia/bulletproof-vest>>.

<sup>94</sup> "Boron Carbide," 31 Aug. 2006, 7 Nov. 2006, <[http://en.wikipedia.org/wiki/Boron\\_carbide](http://en.wikipedia.org/wiki/Boron_carbide)>.

Armor plates comprised of a hard layer (ceramic) backed by a soft layer (fibers) highlight the two key features of armor design: materials and geometry. These are the only variables available to armor designers—either the material itself or the positioning of material is changed. Over the past 30 years changes were primarily in materials improvements—the geometry of a hard layer backed by a soft layer has remained the same.

## **B. COMPETITION**

Over the last few years, ceramic armor has become a booming business. In 2001 the industry brought in over \$200 million dollar annually in the United States and it is expected to continue to grow steadily until at least 2007.<sup>95-96</sup> But many manufacturers in this sector say that it is not by any means an easy business, even in the best of circumstances. Extremely cyclical demand, particularly for body armor, has made it difficult to invest in the capital equipment and research and development efforts necessary to advance armor technology. At the same time, a highly competitive environment has made it necessary for companies to continue to find ways to reduce costs while increasing their armor performance and manufacturing capacity.<sup>97</sup>

The body armor industry is best characterized from a consumer's perspective as volatile and fragmented. Within it lies a variety of players, including government organizations (which create, develop, and enforce regulations and standards), raw material suppliers, fiber manufacturers, mills and fabric producers, finished goods manufacturers, and suppliers and distributors.<sup>98</sup> With many of the players vertically integrating it is difficult to attach an exact number to manufacturing firms in totality.

---

<sup>95</sup> National Institute of Justice, 6.

<sup>96</sup> Joy LePree, "Protective Clothing and Body Armor Industry: Fire, Chemicals and Bullets," BBC Research, 1 November 2002.

<sup>97</sup> Christine L. Grah, "Saving Lives with Ceramic Armor," Ceramic Industry, June 2003: 29.

<sup>98</sup> LePree.

However, as of 2001 more than 80 manufactures produce body armor and participate in the National Institute of Justice's voluntary compliance testing program.<sup>99</sup>

For the past six years Department of Defense body armor contracts have primarily been awarded to three companies: Armor Holdings Inc., Ceradyne Inc., and DHB Industries Inc. These firms received the majority of the body armor contracts primarily due to their production capability and consequently ability to fulfill delivery requirements during critical times of shortage. In order for these firms to produce body armor however, they depend first on raw material suppliers to produce quality materials to sustain competitive advantage.

## **C. MAJOR PLAYERS IN THE BODY ARMOR MARKET**

### **1. Leading Raw Material Suppliers**

Several organizations are involved in both development and production of the refining materials used in body armor. The most recognized brand is Kevlar®. Kevlar® was first produced by DuPont in 1965 and was the first material identified for use in the modern generation of body armor.<sup>100</sup> DuPont is the only domestic producer of the para-aramid fiber panels used in vests.<sup>101</sup> DuPont has continued to improve its Kevlar® brand; its newest release is the Kevlar® Protera. DuPont states its Protera line is a high-performance fabric that allows lighter weight, more flexibility and greater ballistic protection due to its molecular structure of fibers.<sup>102</sup>

Honeywell another key domestic manufacturer produces Spectra® fibers, an ultra-high strength polyethylene fiber, as well as GoldFlex® and Spectra Shield® made from aramid fibers. Honeywell was the only domestic producer of Spectra Shield® used to make ceramic plates until April 2004, when DSM Dyneema (a Netherlands firm)

---

<sup>99</sup> National Institute of Justice, 6.

<sup>100</sup> "DuPont Kevlar," 3 December 2006 <<http://www.dupont.com/kevlar/whatiskevlar.html>>.

<sup>101</sup> Government Accountability Office, Defense Logistics, 79.

<sup>102</sup> Mary Bellis, "History of Body Armor and Bullet Proof Vests," June 2005, 10 October 2006 <[http://inventors.about.com/od/bstartinventions/a/Body\\_Armor.htm](http://inventors.about.com/od/bstartinventions/a/Body_Armor.htm)>.

opened a manufacturing plant in South Carolina to produce Dyneema®, a superstrong polyethylene fiber like Spectra®.<sup>103</sup> According to a 2005 Government Accountability Office report, Spectra Shield® and Dyneema® are the only materials that meet military ballistic protection and weight requirements for Interceptor Body Armor. Due to their limited availability, both materials are under Defense Priorities and Allocation System control.<sup>104</sup>

Other foreign manufacturers also produce high performance fibers but are not yet considered for U.S. military use, but are used for law enforcement and other uses. A Netherlands company, Teijin Twaron produces Twaron®, a para-aramid polymer fiber like Kevlar®.<sup>105</sup> Additionally, the Japanese company, Toyobo, produces the controversial product, Zylon®, a poly pheylenebenzobisoxazole.<sup>106</sup> New studies report Zylon® degrades rapidly, leaving wearers with significantly less protection than expected. Consequently, the company recently underwent litigation concerning the faulty material and settled lawsuits agreeing to pay damages of \$2.3 million.<sup>107</sup>

All manufacturers claim their respective products have advantages over their competitors, whether in weight, strength, versatility or durability, and likewise that their product is premier. It also important to note, the fibers and ceramic materials manufactured by these firms have a wide variety of uses, in addition to ballistic garments. Their materials are important components in ropes, cables and nets in the fishing, shipping and offshore industries. They are also used in safety gloves for the metalworking industry and in fine yarns for applications in sporting goods and the medical sector.<sup>108,109</sup>

---

<sup>103</sup> “DSM Dyneema,” 10 November 2006  
<[http://www.dsm.com/en\\_US/html/hpf/home\\_dyneema.htm](http://www.dsm.com/en_US/html/hpf/home_dyneema.htm)>.

<sup>104</sup> Government Accountability Office, Defense Logistics, 79.

<sup>105</sup> “Teijin Twaron Corporate Information,” 10 November 2006 <<http://www.twaron.com>>.

<sup>106</sup> “Products,” 12 November 2006 <<http://www.toyobo.co.jp/e/products>>.

<sup>107</sup> “US: Court Rules Toyobo to Pay Out for Bullet-Proof Fabric Failure,” 9 November 2006  
<<http://www.just-style.com>>.

<sup>108</sup> “Teijin Twaron Corporate Information,” 10 November 2006 <<http://www.twaron.com>>.

<sup>109</sup> “DSM Dyneema,” 10 November 2006,  
<[http://www.dsm.com/en\\_US/html/hpf/home\\_dyneema.htm](http://www.dsm.com/en_US/html/hpf/home_dyneema.htm)>.

## 2. Leading Body Armor (Finished Good) Makers

The leading material suppliers promote their products to manufacturing firms to make body armor for customers. A Government Accountability Office report stated that the Defense Logistics Agency increased its number of vest suppliers from 1 to 4; plate manufacturers from 3 to 8 (including manufacturers of overweight plates); and ceramic tile suppliers from 4 to 10 (including suppliers of overweight tiles) during periods of “critical shortage” over the past six years.<sup>110</sup> However, body armor contracts were primarily awarded to three key companies: Armor Holdings Inc.(subsidiary Second Chance Body Armor) – Jacksonville, FL; DHB Industries (subsidiary Point Blank Body Armor) - Pompano Beach, FL; Ceradyne - Costa Mesa, CA.

**Armor Holdings, Inc.:** Armor Holdings, Inc. (NYSE: AH), is a diversified manufacturer of branded products for the military, law enforcement and personnel safety markets with 5,100 employees and a grossed profit of \$1.72B in 2005.<sup>111</sup> Armor Holdings’ Aerospace & Defense Group is a top supplier of human safety and survival systems to all branches of the U.S. military and major aerospace and defense prime contractors. Armor Holdings was incorporated in 1996 and is a member of the S&P Smallcap 600 Index. By April of 2006, Armor Holdings was named a FORTUNE 1000 company, and in September, the company became the third fastest growing company in the U.S. on Fortune's “100 Fastest Growing Companies” list. The Armor Holdings’ Aerospace & Defense Group, which generated revenues of \$1.2 billion in 2005, provides advanced survivability systems to US and international military forces, as well as major aerospace and defense prime contractors. They claim to have pioneered many of the survivability products that the US military relies on—specifically the Small Arms Protective Insert (SAPI) plates, which fall under the Individual Equipment System section of the Aerospace & Defense Group. The Aerospace & Defense Group employs about 2,200 people with over 850,000 square feet of space in 14 locations throughout the United States.<sup>112</sup>

---

<sup>110</sup> Government Accountability Office, Defense Logistics, 83.

<sup>111</sup> “Armor Holdings Corporate Governance - Highlights,” 3 December 2006 <<http://phx.corporate-ir.net/phoenix.zhtml?c=77648&p=irol-govhighlights>>.

<sup>112</sup> “About Armor Holdings,” 13 November 2006 <<http://www.armorholdings.com/corporate/aboutus.html>>.



**DHB Industries Inc.:** Founded in 1994, DHB Industries Inc. is a publicly traded (OTC Pink Sheets: DHBT.PK) company comprised of two divisions: DHB Armor Group and DHB Sports Group. DHB Armor Group consists of Point Blank Body Armor, Inc. (acquired in 1995) and Protective Apparel Corporation of America (PACA) (acquired in 1992). They are the self-proclaimed global leaders in the development, manufacturing and distribution of innovative, technically advanced bullet and projectile resistant garments, bullet resistant and fragmentation vests, bomb projectile blankets, and related ballistic accessories and technologies for the United States Military and Law Enforcement Agencies. DHB has 950 employees and grossed \$354M in 2005.<sup>113</sup> Point Blank Body Armor and Protective Apparel Corporation of America are in the protective body armor industry and are focused on the design, manufacture, and distribution of bullet resistant and protective body armor for military, law enforcement, and corrections in the U.S. and worldwide.<sup>114</sup>

**Ceradyne, Inc.:** Founded in 1967, Ceradyne, Inc. (NasdaqNM: CRDN) is a worldwide leader in the development and production of advanced technical ceramics with 1,835 employees and 2005 revenues of approximately \$435M.<sup>115</sup> Vertically-integrated manufacturing facilities produce advanced technical ceramic solutions for the most demanding applications in automotive/engine, industrial wear, medical, electronic and defense industries. Vertically-integrated capabilities include: Powder Production, Ceramics Fabrication, Armor Fabrication, System Integration and Ballistic Evaluation.<sup>116</sup>

Armor Holdings Inc. and DHB Inc. both focus on body armor manufacturing (assembly), whereas Ceradyne Inc. solely focuses on ceramic plate manufacturing. Like the raw material producers, the body armor manufacturers also have footholds in other product markets in addition to body armor. Figure 6 depicts the flow of products from the raw material suppliers to customers and categorizes the firms mentioned in this report; it also shows the governing organizations.

---

<sup>113</sup> “DHB Industries Inc.” 13 November 2006 <<http://www.dhbt.com>>.

<sup>114</sup> “DHB Industries Inc.” 13 November 2006 <<http://www.dhbt.com>>.

<sup>115</sup> “Ceradyne Inc Investor Relations,” 13 November 2006, <<http://www.ceradyne.com>>.

<sup>116</sup> “Ceradyne Inc. Armor Systems,” 3 December 2006, <<http://www.ceradyne.com/>>.

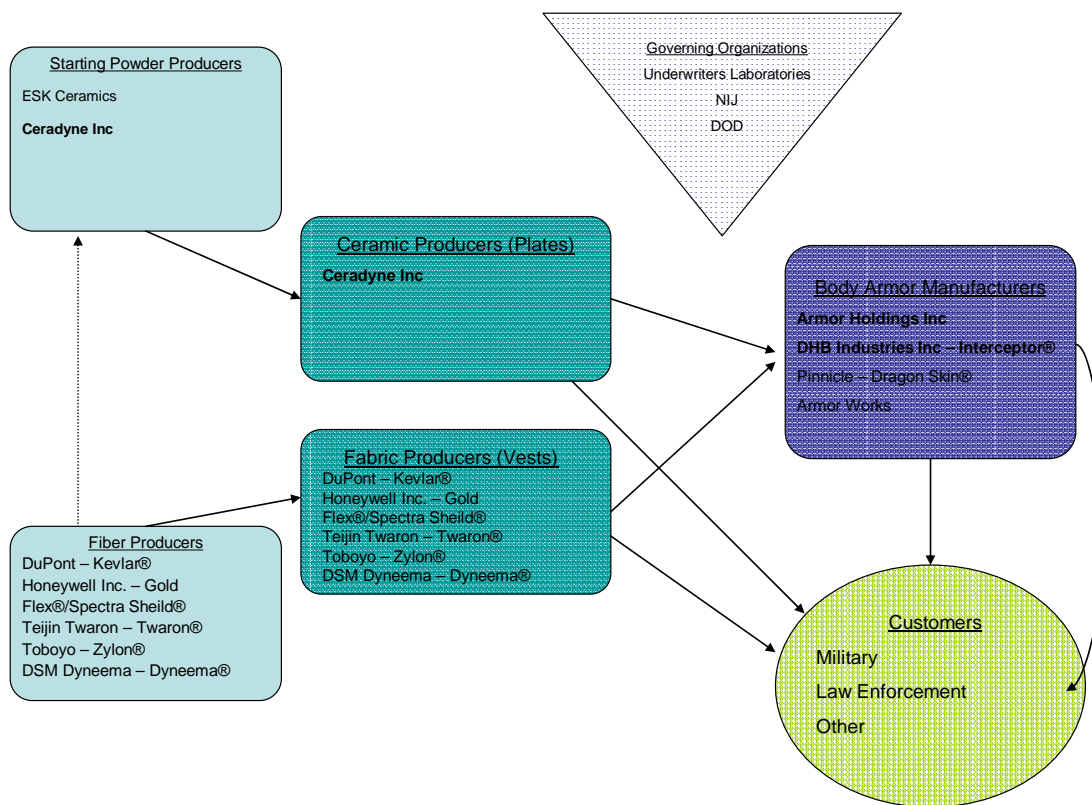


Figure 6. Body Armor Industry Product Flow Diagram

#### D. INDUSTRY STRATEGIES

Since January 1, 1996, Armor Holdings Inc. has completed 26 acquisitions and integrated the acquired businesses into the three business units. They seek opportunities to make value-based acquisitions that complement our business operations or expand product offerings, improve technology, provide access to new geographic markets or provide additional distribution channels and new customer relationships. Historically they claim to take a disciplined value-based approach to evaluating acquisition opportunities, driven by a discreet use of capital, thorough standards and a targeted expected return on investment.<sup>117</sup>

<sup>117</sup> “Armor Holdings Corporate Governance - Highlights,” 3 December 2006 <<http://phx.corporate-ir.net/phoenix.zhtml?c=77648&p=irol-govhighlights>>.

Ceradyne Inc. has diversified its advanced technical ceramic product lines to capture opportunities created by growing demands for better materials performance. In late 2004, the company added new product lines and new markets—and one of the world's leading suppliers of starting powders for manufacturing advanced ceramics products—by acquiring ESK Ceramics of Kempten, Germany. They plan to commit their armor research and development resources to the next generation “threat protection” as well as capitalize on early stage prototype ground vehicle designs.<sup>118</sup>

DHB Industries Inc. created with the singular purpose of achieving dominant market leadership positions in highly targeted, growth oriented industries, has focused on the execution of a three-pronged strategic plan: 1) Accelerated growth through acquisition; 2) Rapid turnaround through operational, management and brand revitalization; and 3) Aggressive sales and marketing of core brands, technologies and products.<sup>119</sup>

There are recurring trends within the industry: acquisition of smaller companies for vertical and lateral growth; investigation of new stronger usable products; and developing customer relationships.

## **E. FINANCIAL EXAMINATION**

While these three key companies all compete for a share of the body armor market, when assessed individually, their direct competition and overall industry category is divergent. Armor Holdings Inc. is categorized in the “Aerospace Defense Products and Services” industry with companies like Lockheed Martin, Honeywell International Inc. and General Dynamics Corporation as its direct competition. Ceradyne Inc. is categorized in the “Industrial Equipment and Components” industry with United Technologies Corp. and Caterpillar Inc. as competition. DHB Inc. is not categorized at all, but lists Armor Holdings Inc. and Ceradyne as its direct competition.<sup>120</sup> This

---

<sup>118</sup> “Ceradyne Inc Investor Relations,” 13 November 2006, <<http://www.ceradyne.com>>.

<sup>119</sup> “DHB Industries Inc.” 13 November 2006 <<http://www.dhbt.com>>.

<sup>120</sup> “Yahoo Finance,” 30 November 2006 <<http://finance.yahoo.com/>>.

diversity makes financial comparison difficult, because “industry [financial] standards” vary among industries.<sup>121</sup> Table 2 illustrates the diversity in the firms’ financial data.

Table 2. Basic Financial Data Comparison of Leading Body Armor Firms<sup>122</sup>

Firm Name:	CRDN	AH	DBHT.PK
<b>Fiscal Year</b>			
Fiscal Year Ends:	31-Dec	31-Dec	31-Dec
Most Recent Quarter (mrq):	30-Sep-06	30-Sep-06	30-Sep-05
<b>Profitability</b>			
Profit Margin (ttm):	17.84%	6.67%	-5.08%
Operating Margin (ttm):	27.66%	11.86%	10.50%
<b>Management Effectiveness</b>			
Return on Assets (ttm):	23.73%	8.29%	16.40%
Return on Equity (ttm):	41.93%	18.11%	-28.07%
<b>Income Statement</b>			
Revenue (ttm):	598.31M	2.01B	354.12M
Revenue Per Share (ttm):	22.661	56.968	7.943
Qtrly Revenue Growth (yoy):	96.80%	25.70%	1.00%
Gross Profit (ttm):	131.14M	368.43M	94.14M
EBITDA (ttm):	186.01M	281.51M	38.08M
Net Income Avl to Common (ttm):	106.72M	134.33M	-18.35M
Diluted EPS (ttm):	3.97	3.65	-0.4
Qtrly Earnings Growth (yoy):	176.80%	-19.60%	N/A
<b>Balance Sheet</b>			
Total Cash (mrq):	175.51M	8.11M	5.49M
Total Cash Per Share (mrq):	6.5	0.228	0.121
Total Debt (mrq):	121.00M	735.31M	15.00M
Total Debt/Equity (mrq):	0.338	0.9	0.253
Current Ratio (mrq):	5.516	0.837	1.857
Book Value Per Share (mrq):	13.245	23.003	1.309
<b>Cash Flow Statement</b>			
Operating Cash Flow (ttm):	106.37M	185.26M	27.33M
Levered Free Cash Flow (ttm):	71.76M	438.72M	37.37M

Additionally, a comparative look at stock market fluctuation of these three key companies over the past five years, see Figure 7, tells a very illuminating tale especially with regard to DHB’s current stock decline. All three companies started doing

<sup>121</sup> Scott B. Smart, Lawrence J. Gitman and L Megginson, Corporate Finance, (Mason: South-Western College Publishing, 2006): 67.

<sup>122</sup> “Yahoo Finance,” 30 November 2006 <<http://finance.yahoo.com/>>.

exceptionally well with the occupation of Iraq in mid-2003. In body armor contracts, DHB benefited the most as they had been for years the primary producers of the OTV standard. Between September 2004 and January 2005, DHB built two additional factories in full anticipation of making in excess of a million OTVs. Ceradyne and Armor Holdings Inc. were also ramping up operations as they too were receiving lucrative DOD contracts during this period for their armor plating technologies.

Unfortunately for DHB Inc., in early 2005 their reputation took a crippling blow. Congressional concerns about the protection capabilities of body armor spurred an investigation that included “Interceptor” vests. The investigation resulted in law suits contending that DHB Inc. executives knew that thousands of vests used defective Zylon® material. In May 2005 the Marine Corps and Army very publicly recalled 18,000 Interceptor OTVs and public outrage was quickly followed by a new round of body armor contracts to DHB competitors. The DOD later would assert that DHB Inc. was in full compliance with their military specification requirements and none of the returned vests were cited as faulty. However, the damage with respect to the stock price plummet was done.<sup>123</sup>

DHB Inc.’s troubles however were not confined to the field. In September 2005 their investors initiated a class action suit against company executives for insider trading and moreover in the past two months two CFOs have resigned and the company has still failed to post its 2005 SEC annual reports.<sup>124</sup> Company legal officials state that the lawsuit has no meaning and point out that the DOD has continued to push contracts to DHB, which is a sign of a continuing good relationship with the military.<sup>125</sup> However, the climb in Armor Holdings Inc. and Ceradyne Inc.’s stock prices are possibly a direct reflection of body armor media coverage and the gaining of DHB Inc.’s lost contracts.

---

<sup>123</sup> Thomas Maier, “Maker of Body Armor Is Under Fire: SEC Probes DHB Industries and Founder as Investors Allege Stock Scheme and Feds Review Vests’ Adequacy,” Newsday, 27 March 2006.

<sup>124</sup> “SEC Charges Former Officers of Military Body Armor Supplier with Financial Fraud,” US Fed News Service, Including US State News, 17 August 2006.

<sup>125</sup> Thomas Maier, “Maker of Body Armor Is Under Fire: SEC Probes DHB Industries and Founder as Investors Allege Stock Scheme and Feds Review Vests’ Adequacy,” Newsday, 27 March 2006.

Whether or not DHB Inc. can manage to lift itself from the ashes remains to be seen but it is anticipated that their manufacturing capabilities and relationship with the military will in one form or another endure.

It is uncertain whether Armor Holdings Inc. will follow the same fate as DHB Inc. A civil suit named Second Chance Body Armor Inc. a subsidiary of Armor Holdings Inc. and its fiber supplier, Toyobo Co., and related entities. The suit alleges that from 1998 until 2001 Toyobo and Second Chance “kept silent as to the ever-mounting information in their possession that the Zylon® fabric degraded substantially faster than expected” when exposed to certain light, temperature and humidity conditions.<sup>126</sup> Both companies already faced suits by law-enforcement groups, state attorneys general, a wounded police officer, and the widow of an officer who was killed while wearing a vest.<sup>127</sup> As for now Armor Holding’s has experienced little to no change in its financial performance.

---

<sup>126</sup> Kara Scannell, “U.S. Sues Maker of Body Armor, Its Fiber Supplier,” Wall Street Journal, (Eastern Edition) [New York, N.Y] 5 July 2005: A18.

<sup>127</sup> Kara Scannell, “U.S. Sues Maker Of Body Armor, Its Fiber Supplier,” Wall Street Journal, (Eastern Edition) [New York, N.Y] 5 July 2005: A18.

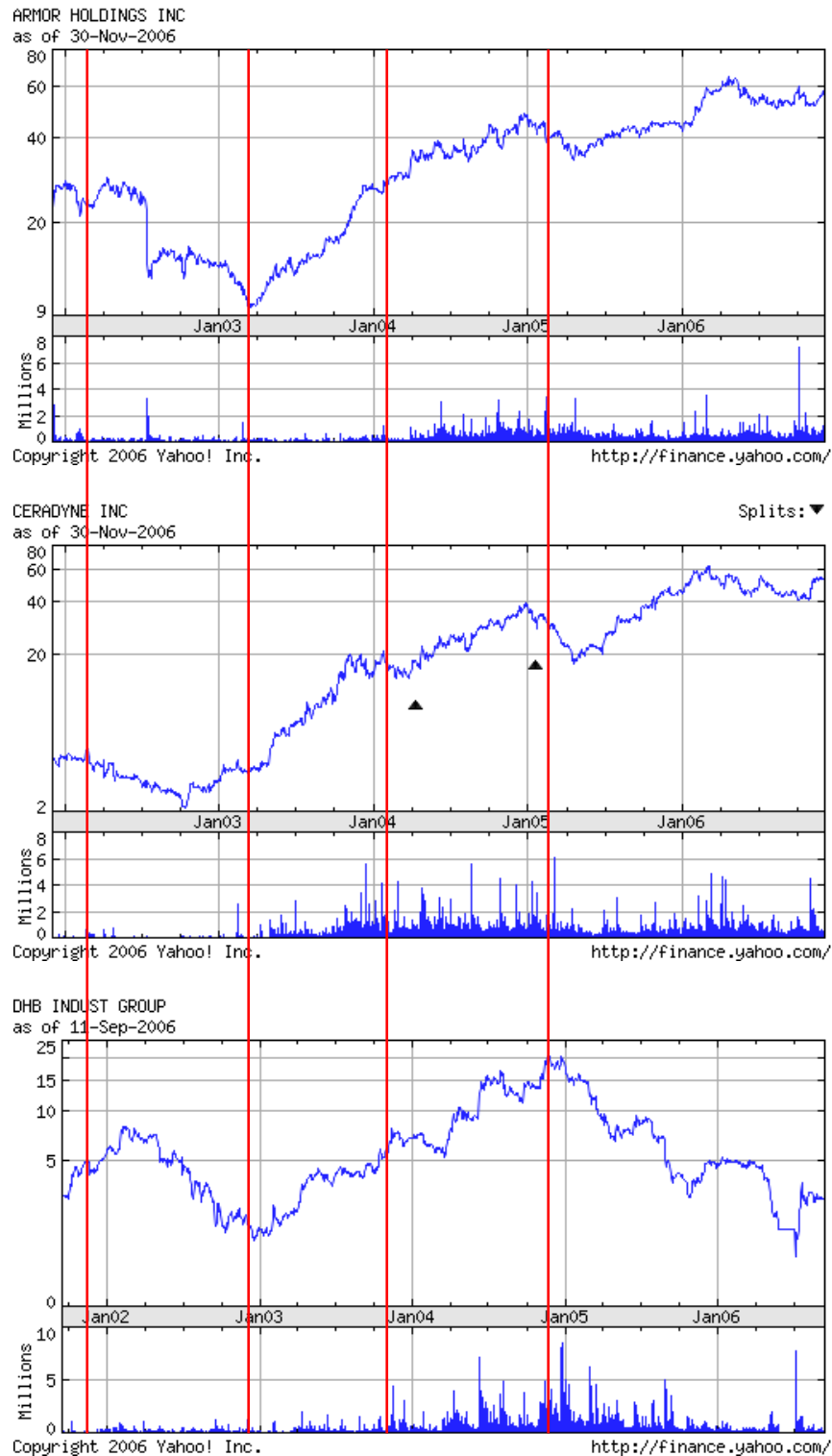


Figure 7. Five Year Stock Price Comparison of Leading Body Armor Firms<sup>128</sup>

<sup>128</sup> "Yahoo Finance," 30 November 2006 <<http://finance.yahoo.com/>>.

## **F. BUYERS**

While the development of body armor arose from a military requirement, products appeal to other organizations and industries as well. The range of body armor protection levels and configurations allow for sales to diverse group of buyers. Military branches are the largest buyer, making massive body armor acquisitions; but, they are closely followed by law enforcement organizations ranging from Department of Justice to local city police departments and by various international customers.

Body armor has found a niche in many areas. Low grade body armor found a niche in the sports in areas such as motocross and paint ball. Additionally, shop owners in both New York and Los Angeles have approached body armor retailers about outfitting their employees with body armor type protection to guard against aggravated assault robberies since the early 1980s. To prevent this type of equipment falling into the wrong hands many body police outfitters that sell bulletproof apparel to civilians will not sell its bulletproof equipment unless the customer has a gun permit or a recommendation from a police department.<sup>129</sup> Additionally, in April 2004 the Defense Criminal Investigative Service executed search warrants in seven states as part of an ongoing investigation into the illegal sale of stolen military ballistic protective equipment on Internet auction sites.<sup>130</sup> Even with protective measures body armor can fall into the wrong hands, for example, a 1997 bank robbery in North Hollywood, California, posed two assailants, each armed with an assault rifle and wearing body armor, against 20 to 30 police officers in a gun battle that left two people dead and more than a dozen people injured.<sup>131</sup>

According to the Department of Justice National Institute of Justice armor purchases are categorized in four groups: 1) Individual, purchased from a distributor or

---

<sup>129</sup> Michael deCourcy Hinds, "One Answer to Violence: Bulletproof Clothing," New York Times, 16 May 1981: 1.21

<sup>130</sup> "Ballistic Vest Search Warrants Served," United States Department of Defense New Release, 8 April 2004 <<http://www.dodig.osd.mil/IGInformation/IGInformationReleases/nr20040408-0537.pdf>>.

<sup>131</sup> Robert L. Mabry, MD, et al., "United States Army Rangers in Somalia: An Analysis of Combat Casualties on an Urban Battlefield," The Journal of Trauma, Injury, Infection, and Critical Care, (September 2000): 515.



retail outlet; 2) Small-quantity departmental purchases; 3) Large-quantity departmental purchases (several hundred units); or 4) As-needed purchases procured through an open ended agreement/contract.<sup>132</sup> Most DOD purchases fall into the latter two categories, but armor is budgeted, acquired and distributed by each service individually.

## **G. DISTRIBUTION**

For non-military customers body armor is distributed through a wide range of retail outlets. The variety of retail outlets range from those that specialize in selling outdoor and sport equipment, to uniform specialists, to so-called “cop shops” (those selling law enforcement gear). For DOD however distribution works differently, not only from that of non-military, but also within the military services.

Since body armor is procured separately for each service, the processes for procurement and subsequent distribution are also separate and distinct. In essence each service utilizes a hub-and-spoke system, where firms deliver body armor to a centralized “distribution center” and then transfer required amounts to users. The U.S. Army utilizes the support of the Defense Logistics Agency to manage its body armor distribution. After distribution problems related to body armor shortages in Iraq the Defense Logistics Agency proposed to take on all distribution for DOD.<sup>133</sup>

## **H. COMPLEMENTS**

Complements are products that add new benefits not present in existing products. Deltoid and Axillary Protectors and Enhanced Side Ballistic Inserts complement the IBA by providing a larger protection area for the wearer. Land Warrior complements IBA by providing integrated communication systems.

---

<sup>132</sup> National Institute of Justice, 58.

<sup>133</sup> Government Accountability Office, Defense Logistics, 86.

## **1. Deltoid and Axillary Protectors and Enhanced Side Ballistic Insert**

Improvised explosive devices (IEDs) use has become a commonplace tactic among terrorist insurgents during Operation Iraqi Freedom (OIF). Combat commanders and medical personnel noticed a shortfall in protection of the upper arm and underarm areas from fragmentary injuries of IEDs. These areas are not currently covered by the IBA. These shortfalls led to the development of Deltoid and Axillary Protectors (DAP) and the Enhanced Side Ballistic Insert (ESBI). DAP weights about 5.3lbs. per set and ESBI weights about 7.1lbs. per set. Figure 8 exhibits the coverage and configuration of the DAP and ESBI. According to the Program Executive Office:

DAP consists of two ambidextrous modular components, the Deltoid (upper arm) Protector and the Axillary (underarm) Protector. The Deltoid Protector attaches at the shoulder of the OTV and is secured around the wearer's arm with a strap. The Axillary Protector is worn under the OTV and is attached to the underside of the shoulder portion of the OTV and to the interior adjustment strap on the lower side of the OTV. The DAP provides the same level of protection as the OTV. They are issued as an assembly of two each Deltoid and Axillary Protectors.

The ESBI consists of two ambidextrous modular components: the carrier assembly and the ballistic insert. The carrier assembly attaches to the OTV by using the webbing on both the front and the back of the carrier, and can be further secured through incorporation with the DAP. The ESBI can use either a 7 x 8 inch ESBI or a size extra small ESAPI. The ESBI will be issued in sets each consisting of two carriers and two inserts.<sup>134</sup>

---

<sup>134</sup> Deltoid and Auxiliary Protectors and Enhanced Side Ballistic Inserts (Program Executive Office Soldier, PM Soldier Equipment, December 2006).

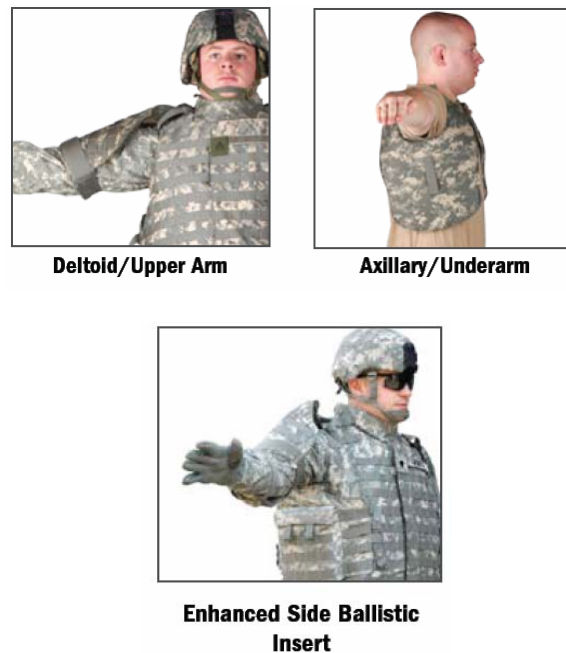


Figure 8.      Photos of DAP and ESBI.<sup>135</sup>

## 2.      Land Warrior

With the dynamic battlefield of today and unknown future hostilities, the US Army set out to develop Land Warrior to increase a soldier's lethality, survivability, battle command, mobility, sustainment, tactical awareness and training and mission rehearsal.<sup>136</sup> The requirement to conduct future military operations in large cities with smaller forces demands individual soldiers with a much greater range of capabilities than exists today.<sup>137</sup> Specifically, the Army identified needed improvements for individual dismounted soldiers to possess the capability of command and control, lethality, survivability, mobility, and sustainment. The Land Warrior system's capabilities contribute to the Joint Vision 2010 operational concept of situational awareness and dominant maneuver by dismounted forces. Land Warrior components include a computer, helmet mounted display (HMD), navigation module, voice/data radio, and a

---

<sup>135</sup> Deltoid and Auxiliary Protectors and Enhanced Side Ballistic Inserts (Program Executive Office Soldier, PM Soldier Equipment, December 2006).

<sup>136</sup> "Land Warrior," 3 December 2006 <<https://peosoldier.army.mil>>.

<sup>137</sup> Hahn and Jezior, 74.

multifunctional laser that are integrated with the mission equipment (body armor and nuclear, biological, chemical equipment<sup>138</sup>). The integrated, modular system approach optimizes fightability with minimal impact on the Soldier's combat load and logistical footprint.<sup>139</sup> Figure 9 represents the Land Warrior technology in action.



Figure 9. Photo of Land Warrior System.

## I. EMERGING TECHNOLOGIES

This section discusses emerging technologies in the body armor field. Emerging technologies are products that have not yet reached the consumer market and are in some state of research, development or production.

### 1. Modular Tactical Vests

The Marine Corps is looking to acquire an integrated Modular Tactical Vest (MTV) system to replace the OTV part of the Interceptor Body Armor system. They state that “OTV lacks efficient state-of-the-art load carrying capabilities that limit the user’s

---

<sup>138</sup> United States, Acquisition of the Army Land Warrior System – Report No. D-2002-143 (Washington D.C.: Office of the Inspector General – Audit, 5 September 2002).

<sup>139</sup> “Land Warrior,” 3 December 2006 <<https://peosoldier.army.mil>>.

effectiveness to carry additional armor and combat load.” They hope the MTV will fulfill the requirement of carrying an assault load (i.e. magazines, water, grenades, etc.). The goal of the MTV is to optimize ballistic protection, and provide load-carrying capabilities better enabling the Marines to configure components to best meet specific missions. With the MTV, Marines also aim to optimize human factors (e.g., comfort and usability), protection (from enemy threats and environment), and cost (production and maintenance).<sup>140</sup> The MTV is about one pound heavier than the Interceptor Outer Tactical Vest system Marines have been wearing in combat since the war in Afghanistan began in October 2001, but officials suggest that the additional pound is offset by improved distribution and comfort.<sup>141</sup> Fielding of the new vests is planned for early FY 2007.<sup>142</sup>

## **2. Dragon Skin**

Pinnacle Armor Inc. of Fresno, California, produces Dragon Skin®. In part this product is a result of a million dollar Small Business Innovative Research project effort granted by the U.S. Army.<sup>143</sup> Dragon Skin® is a flexible scalar style ballistic vest that claims to be superior in ballistic capability and durability to conventional SAPI ceramic plates. It has certified at multi-hit NIJ Level III and is pending Level IV protection levels. The design consists of silver dollar-sized (perhaps slightly larger) circular ballistic ceramic or titanium discs that are configured like fish scales over a given area. The vests

---

<sup>140</sup> Modular Tactical Vests (Marine Corps Systems Command, Combat Equipment Support Systems, Program Manager Infantry Combat Equipment, August 2006).

<sup>141</sup> Gordon Lubold, “Corps releases First Details of New Body Armor Vest,” Marine Corps Times, 20 October 2006: 1-2.

<sup>142</sup> Modular Tactical Vests (Marine Corps Systems Command, Combat Equipment Support Systems, Program Manager Infantry Combat Equipment, August 2006).

<sup>143</sup> Maj. Gen. Jeffrey Sorenson, deputy, Acquisition and Systems Management, for the Assistant Secretary of the Army, Acquisition, Logistics and Technology, DoD News Briefing with Maj. Gen. Sorenson, 31 March 2006.

can be custom configured up to complete torso coverage. The discs are composed of advanced ceramic or titanium composite matrixes and laminates that have the ability to incorporate other materials.<sup>144</sup>

However, Dragon Skin® has not yet met testing criteria for the U.S. Army and is not approved for procurement or use.<sup>145</sup> In contrast, the Air Force Office of Special Investigations concluded that the Dragon Skin® did not fail any written contract specifications with the Air Force after confirming tests conducted by the Aberdeen Test Center in February 2006. AFOSI is optimistic about fulfilling their contract.<sup>146</sup>

### **3. Liquid Body Armor**

The heart of the liquid armor is a Shear Thickening Fluid (STF), which is composed of hard particles suspended in a liquid. The liquid, polyethylene glycol, is combined with hard nanoparticles of silica. Together, they produce STF that stiffens instantly into a shield when hit hard by an object. It reverts to its liquid state just as fast when the energy from the projectile dissipates. The product is non-toxic and can withstand a wide range of temperatures.<sup>147</sup>

For the past five years the University of Delaware Center for Composite Materials has been actively developing STF technology. Chemical Engineering Professors Norman Wagner, Alvin B. and Julia O. Stiles collaborated with Eric Wetzel of the U.S. Army Research Laboratory's Weapons and Materials Research Directorate to create this product. STF can be made into conventional ballistic fabrics or other armor materials applications, because the claim is that materials remain flexible under normal wear but simultaneously becoming resistant to penetration when struck by a spike, knife or high

---

<sup>144</sup> David Crane, "High-Tech Flexible Body Armor Defeats Rifle Threats," Defense Review, 27 May 2006, 6 September 2006 <<http://www.defensereview.com/index.php>>.

<sup>145</sup> Sorenson, 2006.

<sup>146</sup> David Crane, "U.S. Air Force Sets the Record Straight on Dragon Skin Body Armor," Defense Review, 26 April 2006, 3 December 2006 <<http://www.defensereview.com/modules.php?name=News&file=article&sid=867>>.

<sup>147</sup> Bill Siuru, "Law and Order," Wilmette October 2006: 62.

velocity projectile or fragment by effectively spreading the energy of the impact over a larger area.<sup>148</sup> Testing revealed that the STF materials worked best when intercalated or integrated into the DuPont(TM) Kevlar®.<sup>149</sup>

Armor Holdings Inc. was selected to assume development responsibility for the technology and will be the sole commercial provider in applications relating to body armor vests, extremity protection, helmets and gloves for protective use worldwide.<sup>150</sup> While liquid armor seems bespoke for combat personnel or law enforcement, the company is initially targeting prisons because the puncture-resistant nature of the fabric. The aim is to protect guards and inmates from stabbing incidences; something current bulletproof vests are not capable.<sup>151</sup> Armor Holdings hopes to keep its basic products priced at about \$500 to \$600 each.<sup>152</sup>

## **J. CHAPTER SUMMARY**

The purpose of this chapter was to examine the body armor industry as a case study as it is most applicable for the United States Air Force. The chapter discussed the body armor industry from its infancy to its current foothold today. In that, unique characteristics were uncovered. The chapter depicted the relatively fragmented nature of the industry, from the assorted variety of firms association with body armor to diversified product production and customers. With tools discussed in Chapter II one can now utilize strategic sourcing applications to analyze the industry.

---

<sup>148</sup> "Liquid Body Armor Technology Licensed by University of Delaware," US Fed News Service, Including US State News, 24 February 2006.

<sup>149</sup> Bill Siuru, "Law and Order," Wilmette, October 2006: 62.

<sup>150</sup> "Liquid Body Armor Technology Licensed by University of Delaware," US Fed News Service, Including US State News, 24 February, 2006.

<sup>151</sup> Michael Arndt, "Body Armor Fit for a Superhero," Business Week, 7 August 2006: 76.

<sup>152</sup> Bill Siuru, "Law and Order," Wilmette, October 2006: 62.

## **IV. FINDINGS AND ANALYSIS**

### **A. OVERVIEW**

The purpose of this chapter is to provide an analysis of the United States body armor industry, using the tools explained in the literature review. It is hoped that this chapter will further illustrate the industry analysis tools and in addition provide insight into the body armor industry. For the purpose of this report, our view of the body armor industry shall be limited to only those firms that are capable of providing body armor to the DOD. There are a plethora of firms throughout the world that sell body armor; however, only those firms that meet both regulatory and production capacity requirements will be considered. This constraint is necessary due to the overall size and complexity of the industry and focusing the scope of the analysis will result in a better product for our given audience.

This chapter begins with an analysis of the body armor industry using Porter's Five Forces framework. Armed with knowledge of the industry, the latter segment of the chapter employs firm-level analysis to examine the industry leader's (Armor Holding Inc) corporate strategies and their competitive advantages. Since the purpose of this project is to outline a recommended approach to industry analysis, this research report performs a firm-level analysis on one firm for illustration purposes. Ideally, firm-level analysis should be performed on multiple firms within the industry. Ultimately, it is hoped that the findings of this report will assist USAF procurement officials with sourcing and negotiation strategies for body armor.



## B. INDUSTRY ANALYSIS

This analysis will focus Michael E. Porter's Five Forces model on the producers of commercial body armor for the DOD. This analysis is informative because the three leading companies, as mentioned in chapter 3, all approach their business model with very contrasting strategies.

### 1. Threat of Entry (Low)

Congressional dissatisfaction of late with the quality of the body armor that the DOD is purchasing has resulted in increased awareness of the industry.<sup>153</sup> This occurrence coupled with news reports of unfilled demand in the field might give the impression that successful entry into this market is a distinct possibility.<sup>154</sup> There may also be a perceived opportunity for profitability; Armor Holdings' revenue increased by \$740 million this past year.<sup>155</sup> Lastly, because body armor is not only targeted to military soldiers but also to police and private security officers, potential entrants could avoid direct competition for military contracts upfront and thus absorb excess demand in the smaller markets. This report will demonstrate that none of these factors should entice a would-be-profiteer from risking his capital in this endeavor.

**Economies of scale:** Uncertain demand makes it difficult to invest in the capital equipment and research and development efforts necessary to compete in the body armor industry. At the same time, this highly competitive environment makes it necessary for companies to continue to find ways to reduce cost while increasing armor performance and manufacturing capability.<sup>156</sup> These industry characteristics give established diversified companies a competitive advantage and create obstacles for new entrants. DHB's subsidiary Point Blank Body Armor and Ceradyne Inc have been in the industry

---

<sup>153</sup> Thomas Maier, "Maker of body armor is under fire: SEC probes DHB Industries and founder as investors allege stock scheme and feds review vests' adequacy," Newsday, 27 March 2006.

<sup>154</sup> Government Accountability Office, Defense Logistics, 76.

<sup>155</sup> "Armor Holdings, Inc. 2004 Annual Report", 9 December 2006 <<http://www.armorholdings.com>>.

<sup>156</sup> Christine L. Grahl, "Saving Lives with Ceramic Armor," Ceramic Industry, June 2003: 29.

since 1973 and 1967 respectfully. Although Armor Holdings Inc was only established in 1996, their body armor production was originally founded in 1969 under their American Body Armor & Equipment subsidiary that specialized in producing vests and tactical armor. The economies of scale that the major companies have with body armor would cause the prospective entrants to come in with either severe cost disadvantages or generate strong reactions from existing firms. The leading companies are also multi-business firms which allow them to reduce the cost by sharing some of the inputs from armor manufacturing and divert excess capacity when they come up on the losing end of contract negotiations. These competitors established their capacities and defense relationships well prior to 11 September 2001 and all have economies of scale advantages that deter new entrants.

**Product differentiation:** The major companies in the body armor industry have established themselves within the industry; their brands and reputations would be extremely hard to replicate at this point. Moreover, patents on body armor technology provide further protection from imitation and sustain product differentiation. The DOD acquisition arm has a long memory and relies on credible contractors. Armor Holdings is the 65<sup>th</sup> largest ranked defense contractor and has well-established relationships within the DOD.<sup>157</sup> For example they were the unquestioned leader in light-tactical vehicle armoring for the U.S. Military, producing 3,945 Up-Armored HMMWVs during 2004.<sup>158</sup> Police departments and private security firms have also aligned themselves over the years with armor companies that they trust. Because of the prior relationships that the companies have accomplished, prospective entrants would need to invest heavily in time and capital to create economically viable market share.

**Capital requirements:** Producing enough equipment for a Department of Defense or a large police department contract would necessitate a huge upfront capital investment in proprietary equipment and acquisition staffing. These startup costs would also have to overcome product differentiation deficiencies in advertising and R&D. In

---

<sup>157</sup> United States, DoD Personnel and Procurement Statistics, 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards-Fiscal Year 2005 (Washington D.C:ISIAD, 2005).

<sup>158</sup> "Armor Holdings, Inc. 2004 Annual Report," 9 December 2006 <<http://www.armorholdings.com>>.

order for a prospective entrant to be even competitive in this market it would also have to accept a risk premium that would be a significant barrier to entry.

**Cost disadvantages independent of scale:** The three major companies definitely can be determined as having an advantage with learning and experience. They have created proprietary technology over the years which contribute to producing body armor in a more efficient manner and thus reduce manufacturing costs. In addition the experience gained by the major companies enable them to develop favorable access to raw materials suppliers and adopt best business practices. Prospective entrants face an uphill battle competing with well established companies because of existing customer and supplier relationships, proprietary technology, and production learning curves.

**Expected retaliation:** Retaliation against a prospective entrant which is a potential threat to market share is expected among all established companies within an industry. While there is currently excess demand, the industry participants understand that this spike in demand is short lived and the challenge is to predict when the market will decline.<sup>159</sup> This suggests that leading companies will use their current capital leverage to discourage and if need be force prospective entrants out of business before they have a foothold in the market.

## **2. Rivalry among Existing Competitors (Low then High)**

Since the occupation of Iraq demand for body armor has outpaced supply making rivalry relatively low, at least for the short term.<sup>160</sup> This dramatic increase in demand stemmed primarily from congressional and media attention that highlighted DOD's inability to provide U.S. service members with the latest body armor.<sup>161</sup> This negative attention caused military services to pay premium prices (~\$4,000 per unit) in order to get the most modern armor to their troops in the field.<sup>162</sup> Furthermore, congressional

---

<sup>159</sup> Christine L. Grahl, "Saving Lives with Ceramic Armor," Ceramic Industry, June 2003: 34.

<sup>160</sup> Christine L. Grahl, "Saving Lives with Ceramic Armor," Ceramic Industry, June 2003: 34.

<sup>161</sup> Vernon Loeb and Theola Labbe, "Body Armor Saves Lives in Iraq; Pentagon Criticized for Undersupply of Protective Vests," The Washington Post (Washington, D.C.), 4 December 2003: A.01.

<sup>162</sup> Charles, Roger. "Bean Counters Don't Get It," Defense Watch, 6 January 2006  
<<http://www.military.com>>.

provisions like the Berry Amendment prevented the Pentagon from buying directly from foreign sources despite domestic supply shortages. The Berry Amendment, established in 1941, requires products deemed essential for military readiness use 100 percent U.S content.<sup>163</sup> These industry conditions have created a favorable market for body armor suppliers and help to keep current rivalry amongst industry competitors low. However, once troops are withdrawn or operation tempo decreases, the expected peace-dividend will likely translate into evaporating demand and increased rivalry within the industry. As for now, it seems that the biggest competition in leading companies is their own internal battles.

From an investor's perspective, DHB's future is questionable and investment in the company is considered speculative by Wall Street analysts.<sup>164</sup> As previously discussed, the DOD has continued to place orders against previously existing contracts through DHB despite fraud charges.<sup>165</sup> The implication of DHB's alleged actions have decreased value for the stakeholders and may result as a loss of future business. The company's stock price has decreased significantly since the announcement of the fraud investigation (see Figure 7). Even still they will have a tough time recovering their business and brand reputation.

Ceradyne has diverted so many of their resources to producing body armor that their CEO addressed shareholder concerns for the company's long term profitability in this year's annual report.<sup>166</sup> The reason for this reassurance is clear: it appears they may have worked themselves into a damaging growth trap from the short term defense growth that constituted 75% of total company sales in 2005. Unless prepared to reapportion resources, come peacetime, Ceradyne may have huge amounts of excess capacity. With so many resources devoted to military sales, Ceradyne could stand lose share in other markets resulting more direct competition with Armor Holdings and DHB for what

---

<sup>163</sup> "Buy America provision Delayed Body Armor for Troops, Pentagon Officials Says," Defense Daily International, 24 June 2005: 1.

<sup>164</sup> "DHB Industries, Inc." 8 April 2006 <<http://www.fool.com/community/pod/2004/040408.htm>>.

<sup>165</sup> "DHB Industries Announces \$10.6Million in New Delivery Orders from the U. S. Army," 14 November 2006 <<http://www.dhbindustries.com/pressroomreleases.asp#111406>>.

<sup>166</sup> "2005 Ceradyne Annual Report", 2006, 9 December 2006 <[http://media.corporate-ir.net/media\\_files/irol/97/97537/reports/2005\\_AR.pdf](http://media.corporate-ir.net/media_files/irol/97/97537/reports/2005_AR.pdf)>.

remains of the body armor market. To offset this threat they are seeking new products and opportunities in the energy, aluminum, chemical, vehicle armor, automotive and medical markets.<sup>167</sup>

On the other hand Ceradyne has the strategic benefits of specialization, reduced transaction costs, and lower switching cost because of the versatility of their ceramics-focused production. As a vertically integrated ceramics material manufacturer Ceradyne has strategically acquired companies in an effort to reduce their supply vulnerabilities and decrease costs. Because they own all the functions supply and demand is synchronized along the chain of products. This allows them to spread their knowledge over several related functions.

As for Armor Holdings, their whole strategy revolves around defense manufacturing and they are irrevocably committed to that market. Because of their strategy they have made tradeoffs that work to their advantage in a lean environment. They are very broad in their scope and their R&D expenditures are also considerable. This equates to diversity and potential first mover advantages that both work to reduce their exposure to risk and spread those costs and technologies across a spectrum of products. They also appear to have traded efficiency for increased political power. Of their 27 manufacturing plants in 10 different countries, Armor Holdings has made a concerted effort to spread themselves across 13 different states that could lead to broader political support.<sup>168</sup>

If demand collapses the leading companies could suffer for their expansion, a pricing war could ensue, and the DOD will regain the ability to negotiate better contracts. Conversely, or one or more firms could exit the market better equalizing the supply and demand. With governmental concern always working to maintain a healthy defense industry, there will always be a few providers kept viable to assure the timely availability of industrial resources to meet current national defense and emergency preparedness requirements.<sup>169</sup> This will intensify rivalry and the DOD will be in a position once again

---

<sup>167</sup> Jerrold J. Pellizzon, "The AeE Classic – Financial Conference," Ceradyne Inc., November 2006 <<http://www.ceradyne.com/uploads/AeA%20Nov%202006.pdf>>.

<sup>168</sup> "Armor Holdings, Inc. 2004 Annual Report," 9 December 2006 <<http://www.armorholdings.com>>.

<sup>169</sup> Government Accountability Office, Defense Logistics, 80.

to demand a fair market value. Consequently all three companies will most likely receive limited contracts for body armor but it appears that Armor Holdings will continue to be the dominant market leader. They are the most committed to a long term balanced portfolio, R&D investments, and DOD interdependency. Lastly while Porter's five forces does not explicitly discuss the added value of complements for a company's product, Armor Holdings wide array and their market leadership certainly creates a positive force inside and out of the organization for the creation of complements. Complements for body armor, as discussed in Chapter III, include communications systems and additional armor coverage.

### **3. Threat of Substitutes (Low)**

The threats of substitutes are low for the body armor industry. There may be those who claim that technology will decrease the amount of soldiers that are needed in the field or the amount of police officers in the street. However, with the Global War on Terrorism (GWOT) and the war in Iraq there are thousands of private military personnel in Iraq in addition to the military soldiers. In the "Warriors for Hire in Iraq" article, Singer estimates that there are 15,000 to 20,000 private military personnel in Iraq.<sup>170</sup> There will always be the threat of war, riots, and crime. As long as they remain the military, police departments, and private security firms will need personnel that are protected with body armor.

While there are no apparent substitutes for body armor, more specific to this analysis is the threat of new technologies for the creation of body armor. Body armor made out of something other than ceramic would cause the big three problems. A fourth firm, Pinnacle Armor, is attempting to enter the market with a revolutionary product called Dragon Skin. As discussed previously in Chapter III, Dragon Skin is a flexible

---

<sup>170</sup> Peter W. Singer, "Warriors for Hire in Iraq" The Brookings Institution 15 April 2006 <<http://www.brookings.edu/views/articles/fellows/singer20040415.htm>>.

scalar style ballistic vest that claims to be superior in ballistic capability and durability to conventional SAPI ceramic plates. The vests can be custom configured up to complete torso coverage.<sup>171</sup>

It is gaining considerable attention and media coverage; however, the vest struggles to meet military standards.<sup>172</sup> A policy letter was sent to procurement organizations and individuals directing them not to purchase the Dragon Skin body armor. To combat this threat Armor Holdings is developing their own version of “flexible armor” that is applied directly to textile materials. Their shear thickening fluid (STF) employs nanotechnology and is still in the R&D phase but a patent application was filed in May 2003.<sup>173</sup>

#### **4. Bargaining Power of Customers (Low then Moderate)**

The same dynamics involved with increasing industry rivalry will similarly shift customer bargaining power toward the customer. Moving ahead then, the body armor industry is an essential part of the overall mission of national Defense and Homeland Security. The major customers for the products are the Department of Defense, police departments, and private security firms. Demand for body armor products within this segment is considered to be inelastic. Politically, all customers are pressured to provide their personnel with quality body armor; it is simply mandatory in the protective services field. However, companies manufacturing body armor lack price-setting power because they are in a specialized market with no appreciable demand from another sector. Furthermore customers understand that their suppliers have dedicated resources to them and large contracts will be competed among them, which may increase the oligopoly

---

<sup>171</sup> David Crane, “High-Tech Flexible Body Armor Defeats Rifle Threats,” Defense Review, 27 May 2006, 6 September 2006 <<http://www.defensereview.com/index.php>>.

<sup>172</sup> Maj. Gen. Jeffrey Sorenson, deputy, Acquisition and Systems Management, for the Assistant Secretary of the Army, Acquisition, Logistics and Technology, DoD News Briefing with Maj. Gen. Sorenson, 31 March 2006.

<sup>173</sup> “Armor Holdings, Inc. Announces Exclusive License Agreement for New 'Flexible Armor' Technology,” PRN 24 February 2006 <<http://www.investors.com/breakingnews.asp?journalid=34876368>>.

influences on the industry. However, these factors coupled with the transparency of competitor pricing found in the government contracting process restore and strengthen customer bargaining power.

## **5. Bargaining Power of Suppliers (Low)**

The leading three producers of body armor are all multi-business companies that utilize economies of scale to produce their products. Supplier power is low because their inputs are basic commodities that are used across numerous industries. Ceramics are predominately made from a nonmetallic (clay) based material and of course textile materials are all readily available. All of the value derived from these materials is created in the big three's fabrication processes. If anyone has an advantage, a case could be made for Ceradyne's backwards integration that should translate into providing them an edge in ceramic proprietary processes and lowering their raw material transaction costs.

## **C. FIRM LEVEL ANALYSIS**

To appreciate how Armor Holding Inc separates itself from major competitors in the industry, this report analyzes the company as a whole. Armor Holdings Inc was founded in 1996 when a group of international investors took over American Body Armor which was under Chapter 11, Bankruptcy and Reorganization.<sup>174</sup> Jonathan Spiller, a British national, became the first CEO of AH. With the goal of becoming the global leader and single-source provider for multiple security product lines, he led AH in an aggressive acquisition campaign, absorbing companies whose product and services provide personal protection and asset security (see Exhibit 3). In less than ten years, AH has built impressive economies of scope, supplying products across law enforcement, military and commercial market.

This research has found that the firm's strategy is both deliberate and emergent. The firm's initial strategy of acquiring companies was deliberate. In the process of its

---

<sup>174</sup> San Diego Independent Media Center 10 December 2006  
<<http://sandiego.indymedia.org/en/2002/11/3224.shtml>>.



acquisitions, it limited its products so that the firm only targeted a focused group of customers. Although acquiring companies that produced and provided different product lines and services, the firm still only caters to militaries, law enforcement agencies, and security firms. In contrast, DHB Industries Inc, AH's major competitor in protective vests, also manufactures protective athletic sports equipment which target a different group of customers.

One key deliberate strategy of the company was the acquisition of armoring companies O'Gara-Hess & Eisenhardt, renamed Centigon, in August 2001, and Simula in 2003. Both companies' revenue-generating potentials in the area of manufacturing commercial and military vehicle and aircraft armor were not realized until after Operation Iraqi Freedom. The numerous casualties from IED (Improvised Explosive Devices) attacks on U.S. ground personnel onboard Humvees and sniper attacks on helicopter pilots operating in Iraq received public and political attention back in the U.S. This resulted to numerous long-term multi-million dollar contracts awarded to AH to "armor-up" DoD Humvees, trucks, and UH-145 helicopters, providing AH \$18.4 million free cash flow in the third quarter of 2003.<sup>175</sup>

Another deliberate strategy mentioned in Armor Holdings' "1997 Report to Stockholders" was the creation of the Armor Training Academy. Taught by former military members, law enforcement and corrections officers, the academy offers courses year-round to its customers and charges them a set fee. These courses range from crowd management, use of batons and investigative techniques. Students completing the course receive certifications recognized by the Defense Technology/Federal Laboratories® Instructor Certification Programs. Jonathan Spiller's, Armor Holdings CEO, intent was to understand the different needs of customers, solidify relationship with customers,

---

<sup>175</sup> Calvin Biesecker, "Armor Holdings Surging Up-Armored Humvees," Defense Daily, 6 November 2003: 1.

reduce potential liability and advertise products via field exposure.<sup>176</sup> This training service provided by the company increased the willingness-to-pay of customers and created an added value to AH over its competitors.<sup>177</sup>

An emergent strategy in the company was its decision to stay within its core competency of manufacturing products and discontinue underperforming operations. In 2003, after successive unprofitable years in consulting and private security services in the international market, the company decided to discontinue the Service Division, keeping only the Armor Training Academy that complements its products through R&D and marketing synergies.

Using a value chain table, the company's competitive advantage over its competitors in the industry is portrayed in the figure below:

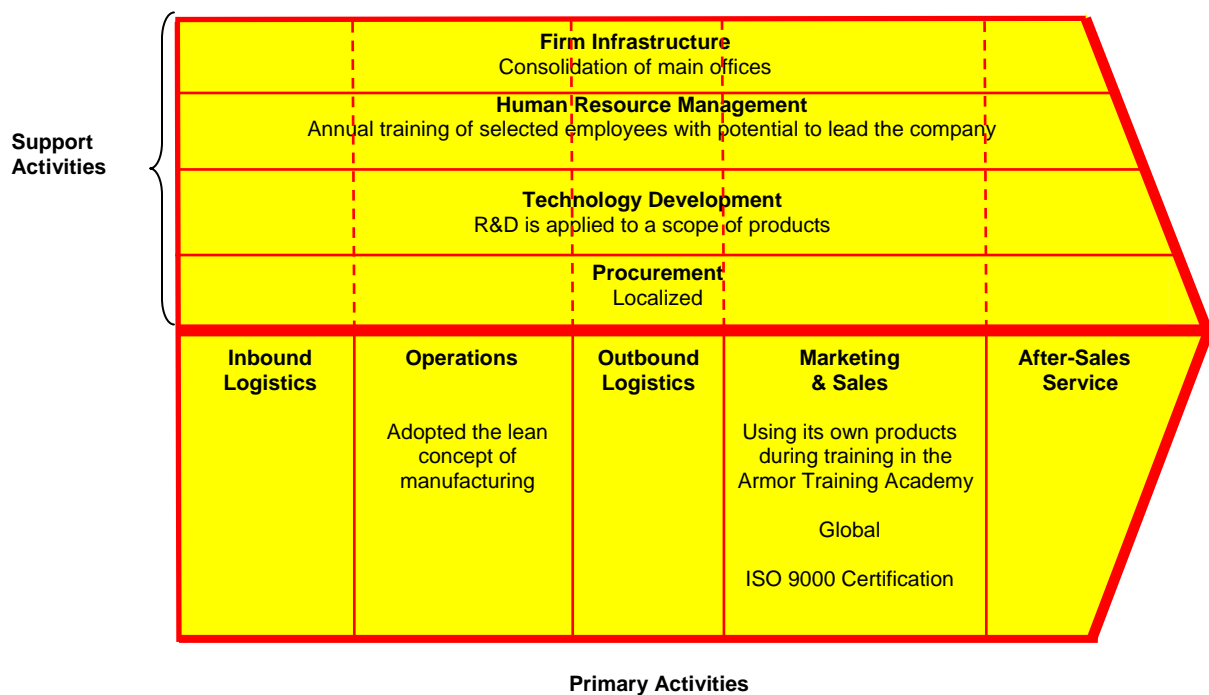


Figure 10. Armor Holdings Value Chain Analysis

<sup>176</sup> Jonathan M. Spiller, "Letter to Shareholders," *Armor Holdings 1997 Annual Report*, 1 December 2006 <[http://media.corporate-ir.net/media\\_files/irol/77/77648//reports/abe\\_971231\\_200\\_100.htm](http://media.corporate-ir.net/media_files/irol/77/77648//reports/abe_971231_200_100.htm)>.

<sup>177</sup> Pankaj Ghemawat and Jan Rivkin, "Creating Competitive Advantage," *Harvard Business School* 20 December 1999.

**FIRM INFRASTRUCTURE** – In 1997, the company closed its office in New York to centralize accounting and administrative offices in Jacksonville, Florida. In 2001, the company consolidated its body armor operations from Florida and Massachusetts facilities into Ontario, CA to achieve efficiency and reduce inventory and transaction costs.<sup>178</sup>

**HUMAN RESOURCES** – Implemented the succession-planning process designed to identify potential leaders within the company and retain proprietary knowledge. Employees from different divisions around the world were nominated and selected to meet with 25 top managers to engage into a 3-day seminar, discussing the history and future plans of the company.<sup>179</sup>

**TECHNOLOGY DEVELOPMENT** – Gaining advantages from its diverse line of products, R&D costs are reduced across its products. They are able to design their products that complement each other (e.g., seat, floatation devices and parachutes for pilots and vest, holster, shield and armor vehicles for ground combatants). The company applied the technology and experience learned from the military to armor commercial vehicles.

**PROCUREMENT** – In 2001, AH began using local suppliers for plants located outside of the U.S. to avoid the high cost of importation duties.

**OPERATIONS** – The use of lean manufacturing concept provided the company flexibility. For instance, the multiple contracts between the Mobile Division and the government to armor military vehicles meant expanding its facilities. Because there were little inventory in the plants, relocations were accomplished over the weekend.<sup>180</sup>

**MARKETING & SALES** – AH sells its products to over 42 countries and each country has a dedicated sales representative. AH believes that having a dedicated representatives ensures commitment, good business relation and a centralized database for customer buying pattern. Their products are used during demonstrations in the Armor

---

<sup>178</sup> “Growth through Acquisitions,” 13 November 2006  
<<http://www.armorholdings.com/corporate/acquisitions.html>>.

<sup>179</sup> “About Armor Holdings,” 13 November 2006  
<<http://www.armorholdings.com/corporate/aboutus.html>>.

<sup>180</sup> Vinas Tona, Industry Week 9 December 2006  
<<https://www.industryweek.com/CurrentArticles/Asp/articles.asp>>.

Training Academy. The appeal brought by Defense Technology/Federal Laboratories® Instructor Certification Programs in ATA courses and the satisfaction they receive with the products during the course is an excellent marketing combination. Highly satisfied students become instant AH customers and representatives in their respective agencies.

#### **D. CHAPTER SUMMARY**

This chapter provided valuable insight into the key drivers of the body armor industry and the industry leader's strategies and competitive advantages. There are three main suppliers of body armor: Armor Holdings Inc, Ceradyne Inc. and DHB Industries Inc. Of this group, Armor Holdings is the clear market leader. This assessment is based partially on the performance of their underlying stock and the revenue streams generated from body armor sales to the DOD.

To analyze the body armor industry the research team used the Porter's Five Forces model, which provided a helpful look into the industry and assisted in explaining how a company like Armor Holdings operates in the defense contracting arena. While not all of Porter's forces carried equal significance in this environment some interesting findings included:

1. There are varied corporate strategies among the industry leaders, all of which have led to some degree of success in a narrowly defined market segment.
2. Excess demand and high willingness to pay do not necessarily bring about a flood of new entrants into a market.
3. Forces are intricately linked to environmental conditions that work to shift industry dynamics as world events change.

Porter's Value Chain model was used to analyze Armor Holdings' competitive advantages. Research revealed that Armor Holdings success is due primarily to both its emergent and deliberate strategies. The company decided to focus on its core competencies and to undertake an aggressive acquisition campaign to broaden its scope. Primary activities like the adoption of the lean concept of manufacturing, and using its

own products during training in the Armor Training Academy created a competitive advantage. The company also expanded geographically and quickly complied with ISO 9000 certification to amplify its appeal to the DOD contracting officials.

This chapter analyzed the combined data from Chapters II and III. Chapter II, the literature review established the tools and models necessary to conduct and industry analysis, while Chapter III provided background information on the body armor industry. The next chapter offers conclusions, recommendations and areas for future research.

## **V. CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH**

### **A. CHAPTER OVERVIEW**

The purpose of this chapter is to summarize the efforts of the previous chapters by providing insight to the results of the analysis, presenting recommendations for research tools and methods used, and offering areas of future research and study. The discussion of results addresses the initial research questions undertaken as well as study limitations and areas of concern. The key recommendations focuses on the models determined most valuable for the case study. Future research areas center on nonmarket forces, joint procurement and further strategic sourcing exploration.

### **B. DISCUSSION OF RESULTS**

#### **1. Realization of Research Questions**

The USAF should utilize industry and firm level analysis to understand the competitive dynamics and key drivers within the industry. However, before analyzing an industry or firm, it is necessary to understand the relationship between strategic sourcing and industry analysis. As previously stated in the literature review, industry analysis is a critical step in the strategic sourcing process, thus proper implementation of both is important. Additionally firm level analysis provides added insight to support industry analysis.

The information gained from conducting industry analysis can benefit the USAF by discerning its position within the industry to enable educated sourcing choices. Equipped with the knowledge provided by a detailed industry analysis, a firm can make more informed decisions concerning their sourcing strategy. Industry analysis provides

the buying organizations with a plethora of valuable information including the strength of the suppliers, buyers and competition within the industry. This information can be utilized to improve an organization's position within a given industry.

## **2. Limitations and Areas of Concern**

Like all research projects, this one has limitations. First, the methodology for this research relied heavily on secondary sources (i.e. printed materials, newspapers, journal articles, and other media sources) as opposed to primary sources (i.e. personal interview and surveys). This limits the scope and data, and restricts triangulation (looking at a problem from multiple views) of the overall research effort. Second, the case study aspect of this research was for the purpose of illustrating strategic sourcing tools rather than actually conducting an industry analysis. Finally, while the literature presents multiple theories and models focused on conducting strategic sourcing and industry analysis, this report focuses on a subset of those prominent theories and models that offer broad applicability.

## **C. KEY RECOMMENDATIONS**

The subset of prominent theories and models discussed in this report all revealed to add some conceptual level of insight into strategic sourcing, an industry, or firm. Therefore the research report recommends inclusion of applicable tools and models into the USAF acquisition process.

First, utilizing strategic sourcing tools provide a systematic procurement framework. This is important to the acquisition community because it helps increase efficiencies in organizational processes, resource allocation and risk management. Specifically, Laseter's Commodity Sourcing Model aims to leverage organizational buying power. Whereas, Kraljic's Portfolio Analysis Model, suggests strategies for buying items based on importance and complexity of the supply market.

Second, utilizing industry analysis tools enables a buying organization to better understand a given industry. Moreover, industry analysis is a critical step in strategic sourcing framework. This is again beneficial to a buying organization because it highlights industry dynamics and identifies key cost drivers. This research report examined two prominent industry analysis models: Porter's Five Forces Framework and SWOT. Porter's framework seeks to account for universal environmental factors that have bearing on a particular industry. SWOT aims to expose how strengths may be leveraged to realize opportunities and how threats and weaknesses can be overcome.

Finally, utilizing firm level analysis, like VRIO and Value Chain Analysis, assists a buying organization in its endeavor to fully understand market forces. Unlike industry analysis, firm level analysis aspires to reveal internal dynamics of an individual firm. This is particularly advantageous to a buying organization because it uncovers the reason(s) for competitive advantage. VRIO focuses on performance-affecting internal resources considered valuable, rare, imitable, and which the firm is organized to exploit to a firm. Value Chain Analysis gives a systematic way of examining all the activities a firm performs and how those activities interact to create a competitive advantage.

## **D. FUTURE RESEARCH**

### **1. Effects of Non-market Forces on Military Procurement**

David Baron states that, "the nonmarket environment includes those interactions that are intermediated by stakeholders, government, the media and public."<sup>181</sup> Nonmarket forces appear to have a significant impact on industry, particularly those associated with the military. While researching this project, many nonmarket forces repeatedly surfaced:

- The effects government policies, such as the Berry Amendment, have on production capacity and subsequent shortage of body armor as discussed in the "rivalries among existing competitors" section of Chapter IV.

---

<sup>181</sup> David P. Baron, "Integrated Strategy: Market and Nonmarket Components," California Management Review, Winter 1995: 1.



- Body armor shortages and funding seemed to position congressional candidates against one another, as to who supported the military or not.<sup>182</sup>
- After the invasion of Iraq the media reported frequently on ill equipped units, causing troops to buy body armor from personal funds before deploying. The American public went as far as holding “bake sales for body armor.”<sup>183</sup> This action snowballed into mandated repayment to soldiers and strict policy that only allows troops to wear government issued equipment.

## **2. Joint Procurement of Body Armor**

The research for this report also revealed segregated research, budgeting, acquisition and procurement processes for each military service as alluded to in the “distribution” section of Chapter III. With many of the military operations moving to Joint efforts, and with the need to “lean” military budgets, it seems that items of universal military use should be jointly managed. Further research could include methods for developing united military procurement processes, cost benefit analysis of joint purchasing and joint spend analysis. Additionally, research could also entail the psychological factors associated with the perception attached to different military services having better protection/equipment over another.

## **3. Expanded Evaluation of Strategic Sourcing Methods**

This research touched on only one step of the Laseter’s Model, however, there are many additional steps not covered in this report that deserve exploration. For example, GAO reports indicate the need for further researches in the area of spend analysis, which could prove useful and beneficial for the DOD.

---

<sup>182</sup> Brooks Jackson, “Pete Ricketts ad: One of the “Worst Deceptions,”” News Net Nebraska, 10 December 2006 <<http://www.newsnetnebraska.org/vnews/display.v/ART/2006/11/05/454dd6a48c4ef>>.

<sup>183</sup> Brian O'Neill, “A Soldier Knows What He Needs,” Post Gazette.com 27 April 2006 <<http://www.post-gazette.com/pg/06117/685448-155.stm>>.

## **E. CHAPTER SUMMARY**

This chapter provided insight to the solution to the report's research question and limitations. It also offered strategic sourcing recommendations for fielding body armor. Lastly, this chapter brought to light three critical areas to focus future research.

THIS PAGE INTENTIONALLY LEFT BLANK

## LIST OF REFERENCES

“2005 Ceradyne Annual Report”, 2006, 9 December 2006 <[http://media.corporate-ir.net/media\\_files/irol/97/97537/reports/2005\\_AR.pdf](http://media.corporate-ir.net/media_files/irol/97/97537/reports/2005_AR.pdf)>.

“About Armor Holdings,” 13 November 2006  
<<http://www.armorholdings.com/corporate/aboutus.html>>.

“Armor Holdings Corporate Governance - Highlights,” 3 December 2006  
<<http://phx.corporate-ir.net/phoenix.zhtml?c=77648&p=irol-govhighlights>>.

“Armor Holdings, Inc. 2004 Annual Report,” 9 December 2006  
<<http://www.armorholdings.com>>.

“Armor Holdings, Inc. Announces Exclusive License Agreement for New 'Flexible Armor' Technology,” PRN 24 February 2006 <<http://www.investors.com/breakingnews.asp?journalid=34876368> >.

“Ballistic Vest Search Warrants Served,” United States Department of Defense New Release 8 April 2004  
<<http://www.dodig.osd.mil/IGInformation/IGInformationReleases/nr20040408-0537.pdf>>.

“Body Armor History,” 5 November 2006  
<<http://www.globalsecurity.org/military/systems/ground/body-armor2.htm>>.

“Boron Carbide,” 31 August 2006, 7 November 2006,  
<[http://en.wikipedia.org/wiki/Boron\\_carbide](http://en.wikipedia.org/wiki/Boron_carbide)>.

“Buy America provision Delayed Body Armor for Troops, Pentagon Officials Says,” Defense Daily International 24 June 2005: 1.

“Ceradyne Inc Investor Relations,” 13 November 2006,<<http://www.ceradyne.com> >.

“Ceradyne Inc. Armor Systems,” 3 December 2006, <<http://www.ceradyne.com/>>.

“DHB Industries Announces \$10.6 Million in New Delivery Orders from the U. S. Army,” 14 November 2006  
<<http://www.dhbindustries.com/pressroomreleases.asp#111406>>.

“DHB Industries Inc.” 13 November 2006 <<http://www.dhbt.com>>.

“DHB Industries, Inc.” 8 April 2006  
<<http://www.fool.com/community/pod/2004/040408.htm>>.

“DSM Dyneema,” 10 November 2006  
[http://www.dsm.com/en\\_US/html/hpf/home\\_dyneema.htm](http://www.dsm.com/en_US/html/hpf/home_dyneema.htm).

“DuPont Kevlar,” 3 December 2006 <http://www.dupont.com/kevlar/whatiskevlar.html>.

“Growth through Acquisitions,” 13 November 2006  
<http://www.armorholdings.com/corporate/acquisitions.html>.

“Interceptor Body Armor,” 20 January 2006  
<http://www.globalsecurity.org/military/systems/ground/interceptor.htm>.

“Land Warrior,” 3 December 2006 <https://peosoldier.army.mil>.

“Liquid Body Armor Technology Licensed by University of Delaware,” US Fed News Service, Including US State News 24 February 2006.

“Products,” 12 November 2006 < <http://www.toyobo.co.jp/e/products> >.

“SEC Charges Former Officers of Military Body Armor Supplier with Financial Fraud,” US Fed News Service, Including US State News 17 August 2006.

“Teijin Twaron, Corporate Information,” 10 November 2006 <http://www.twaron.com>.

“Teijin Twaron,” 4 November 2006  
[http://www.dsm.com/en\\_US/html/hpf/home\\_dyneema.htm](http://www.dsm.com/en_US/html/hpf/home_dyneema.htm).

“US: Court Rules Toyobo to Pay Out for Bullet-Proof Fabric Failure,” 9 November 2006  
<http://www.just-style.com>.

“Yahoo Finance,” 30 November 2006 <http://finance.yahoo.com/>.

Arndt, Michael. “Body Armor Fit for a Superhero,” Business Week 7 August 2006: 76.

Barney, Jay and Patrick Wright, “On Becoming a Strategic Partner: The Role of Human Resources in Gaining Competitive Advantage,” Human Resources Management Spring 1998: 37.

Barney, Jay. “Firm Resources and Sustained Competitive Advantage,” Journal of Management 1991: 99-120.

Baron, David P. “Integrated Strategy: Market and Nonmarket Components,” California Management Review Winter 1995: 1.

Bellis, Mary. “History of Body Armor and Bullet Proof Vests,” June 2005, 10 October 2006 [http://inventors.about.com/od/bstartinventions/a/Body\\_Armor.htm](http://inventors.about.com/od/bstartinventions/a/Body_Armor.htm).

Biesecker, Calvin. “Armor Holdings Surging Up-Armored Humvees,” Defense Daily 6 November 2003: 1.

Blachford Stacey L. and Thomson Gale, eds., "Bulletproof Vest," How Products are Made, 2002, 17 October 2006 <<http://science.enotes.com/how-products-encyclopedia/bulletproof-vest>>.

Camm, Frank. "Strategic Sourcing in the Air Force," Strategic Appraisal: The United States Air and Space Power in the 21st Century.

Charles, Roger. "Bean Counters Don't Get It," Defense Watch, 6 January 2006 <<http://www.military.com>>.

Crane, David. "High-Tech Flexible Body Armor Defeats Rifle Threats," Defense Review, 27 May 2006, 6 September 2006 <<http://www.defensereview.com/index.php>>.

Crane, David. "U.S. Air Force Sets the Record Straight on Dragon Skin Body Armor," Defense Review, 26 April 2006, 3 December 2006 <<http://www.defensereview.com/modules.php?name=News&file=article&sid=867>>.

Deltoid and Auxiliary Protectors and Enhanced Side Ballistic Inserts (Program Executive Office Soldier, PM Soldier Equipment, December 2006).

Ghemavwat, Pankaj and Gary Pisano. "Sustaining Superior Performance: Commitments and Capabilities," Harvard Business School July 1997: 1-20.

Ghemawat, Pankaj and Jan Rivkin. "Creating Competitive Advantage," Harvard Business School 20 December 1999.

Grahl, L. "Saving Lives with Ceramic Armor," Ceramic Industry, June 2003: 34.

Hahn II, Robert F. and Bonnie Jezior, "Urban Warfare and the Urban Warfighter of 2025," Parameters, Summer 1999, 74.

Hinds, Michael deCourcy. "One Answer to Violence: Bulletproof Clothing," New York Times 16 May 1981: 1.21

Jackson, Brooks. "Pete Ricketts ad: One of the "Worst Deceptions," News Net Nebraska 10 December 2006 <<http://www.newsnetnebraska.org/vnews/display.v/ART/2006/11/05/454dd6a48c4ef>>.

Jenson, Christopher. "Personal Correspondence." E-mail to USAF/SFXX. 24 January 2006.

Johnson III, Clay. "Office of Management and Budget: Implementing Strategic Sourcing Memorandum," 20 May 2005.

Kamann, Dirk-Jan F. "The Strategic Value of Proper Purchasing," Management Clout.

- Kraljic, Peter. "Purchasing Must Become Supply Management," Harvard Business Review September 1983: 109-117.
- Kramlich II., Gary R. "The Effects of Posture, Body, Armor, and Other Equipment on Rifleman Lethality," (Thesis, Naval Postgraduate School, 2005), p. xvii.
- Landis, Jeff. "Marines Issue Best Body Armor in the World," The Officer, October 2005: 31.
- Laseter, Timothy M. Balanced Sourcing: Cooperation and Competition in Supplier (San Francisco: Booz-Allen & Hamilton Inc., 1998).
- LePree, Joy. "Protective Clothing and Body Armor Industry: Fire, Chemicals and Bullets," BBC Research, 1 November 2002.
- Lubold, Gordon. "Corps Releases First Details of New Body Armor Vest," Marine Corps Times 20 October 2006: 1-2.
- Mabry, Robert L., et al., "United States Army Rangers in Somalia: An Analysis of Combat Casualties on an Urban Battlefield," The Journal of Trauma, Injury, Infection, and Critical Care, (September 2000): 515.
- Maier, Thomas. "Maker of Body Armor Is Under Fire: SEC Probes DHB Industries and Founder as Investors Allege Stock Scheme and Feds Review Vests' Adequacy," Newsday 27 March. 2006.
- Miller, George A. "Wordnet, Cognitive Science Laboratory," 20 November 2006 <<http://wordnet.princeton.edu/>>.
- Modular Tactical Vests (Marine Corps Systems Command, Combat Equipment Support Systems, Program Manager Infantry Combat Equipment, August 2006).
- Monczka, Robert. et al., Purchasing and Supply Chain Management (Mason: South-Western, 2005).
- Moore, Nancy Y. et al., Using a Spend Analysis to Help Identify Prospective Air Force Purchasing and Supply Management Initiatives. (Arlington: Rand Corporation, 2004).
- O'Neill, Brian. "A Soldier Knows What He Needs," Post Gazette.com 27 April 2006 <<http://www.post-gazette.com/pg/06117/685448-155.stm>>.
- Pellizzon, Jerrold J. "The AeE Classic – Financial Conference" Ceradyne Inc. November 2006 <<http://www.ceradyne.com/uploads/AeA%20Nov%202006.pdf>>.
- Porter, Michael E. "Toward a Dynamic Theory of Strategy," Strategic Management Journal Winter 1991: 95-117.

Porter, Michael E. *Competitive Advantage: Creating and Sustaining Superior Performance* (New York: The Free Press, 1985).

Porter, Michael E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, (New York: The Free Press, 1980).

Rendon, Rene G. *Commodity Sourcing Strategies: Supply Management in Action*. (Monterey: Naval Postgraduate School, 2005).

San Diego Independent Media Center 10 December 2006  
<<http://sandiego.indymedia.org/en/2002/11/3224.shtml>>.

Scannell, Kara. "U.S. Sues Maker of Body Armor, Its Fiber Supplier," *Wall Street Journal*, (Eastern Edition) [New York, N.Y.] 5 July 2005: A18.

Simon, Scott. "A priest's Early Quest to Create A Bulletproof Vest," NPR, Weekend Edition 30 April 2005 <<http://www.npr.org/templates/story/story.php?storyId=4625858>>.

Singer, Peter W. "Warriors for Hire in Iraq" *The Brookings Institution* 15 April 2006  
<<http://www.brookings.edu/views/articles/fellows/singer20040415.htm>>.

Siuru, Bill. "Law and Order," *Wilmette* October 2006: 62.

Smart, Scott B. et al., *Corporate Finance* (Mason: South-Western College Publishing, 2006): 67.

Sorenson, Jeffrey. deputy, Acquisition and Systems Management, for the Assistant Secretary of the Army, Acquisition, Logistics and Technology, DoD News Briefing with Maj. Gen. Sorenson, 31 March 2006.

Spiller, Jonathan M. "Letter to Shareholders," *Armor Holdings 1997 Annual Report*  
<[http://media.corporateir.net/media\\_files/irol/77/77648/reports/abe\\_971231\\_200\\_100.htm](http://media.corporateir.net/media_files/irol/77/77648/reports/abe_971231_200_100.htm)>.

United States, Acquisition of the Army Land Warrior System – Report No. D-2002-143 (Washington D.C.: Office of the Inspector General – Audit, 5 September 2002).

United States, Department of Justice, *Selection and Application Guide to Personal Body Armor*. (Rockville: The National Institute of Justice, 2001).

United States, Director of Logistics Readiness, Deputy Chief of Staff/Logistics, Installations and Mission Support, Brigadier General Gary T. McCoy, Department of the Air Force Presentation to the Tactical Air and Land Forces Subcommittee Committee on Armed Services United States House of Representatives, (Washington D.C.: 15 June 2006) 2-3.



United States, DoD Personnel and Procurement Statistics, 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards-Fiscal Year 2005 (Washington D.C.:ISIAD, 2005).

United States, Government Accountability Office, Best Practices: Using Spend Analysis to Help Agencies Take a More Strategic Approach to Procurement (Washington D.C.: GAO, 2004).

United States, Government Accountability Office, Defense Logistics: Actions Needed to Improve the Availability of Critical Items during Current and Future Operations (Washington D.C.: GAO, 2005).

Valentin, E.K. "SWOT Analysis From A Resource-Based View," Journal of Marketing Theory and Practice Spring 2001: 54-69.

Vernon, Loeb and Theola, Labbe, "Body Armor Saves Lives in Iraq; Pentagon Criticized for Undersupply of Protective Vests," The Washington Post (Washington, D.C.) 4 December. 2003: A.01.

Vinas Tona, Industry Week 9 Dec. 2006  
<<https://www.industryweek.com/CurrentArticles/Asp/articles.asp>>.

Walker, James D. "Turning Bullets into Baseballs," Southwest Research Institute Technology Today, Spring 1998: 1.

## **INITIAL DISTRIBUTION LIST**

1. Defense Technical Information Center  
Ft. Belvoir, Virginia
2. Dudley Knox Library  
Naval Postgraduate School  
Monterey, California